HRS DOCUMENTATION RECORD COVER SHEET

Name of Site: Lukachukai Mountains Mining District
USEPA ID No.: NNN000920223

Contact Person
Documentation Record:

Kenyon Larsen
Remedial Project Manager
U.S. Environmental Protection Agency, Region 9
75 Hawthorne St, Mail Code: SFD-6-4
San Francisco, CA 94105
(415) 972-3105

Ingrid Chen, PE
Project Manager
Tetra Tech, Inc.
1999 Harrison St., Suite 500
Oakland, CA 94608
(510) 302-6234

The Lukachukai Mountains Mining District (LMMD) site is situated around the community of Cove, Apache County, Arizona, and is entirely on the Navajo Nation.

Pathways, Components, or Threats Not Scored

Ground Water Migration Pathway
No municipal wells within a 4-mile radius of the site serve as potable supplies; however, shallow wells do serve the Cove community. The hydrogeology in aquifers providing water for drinking and livestock watering are complex and not fully characterized; further groundwater characterization is a goal for listing on the National Priorities List (NPL). In addition, the population served by the wells is low in the Cove community. Groundwater quality is a significant concern for nearby residents since groundwater is the only dependable local water source other than imported water. This pathway is unlikely to greatly impact the site score. The ground water migration pathway will not be scored as part of this Hazard Ranking System (HRS) package.

Surface Water Migration Pathway
Although several contaminants directly attributable to past uranium mining activities are present at elevated concentrations in sediments in the Cove Wash Watershed, surface water is not used for drinking water and no fisheries are on the site. While some isolated riparian wetlands are found along several branches of the Cove Wash, other surface water sensitive environments are limited on the site. Mine releases, including from waste piles, pose a threat to sensitive terrestrial environments, including the habitat for the Mexican spotted owl, which are scored under the soil exposure and subsurface intrusion pathway. Therefore, as the threat posed by the soil exposure component is sufficient alone to qualify the site for the NPL, the surface water migration pathway is not scored.

Air Migration Pathway
No data are available to satisfy the HRS requirements for establishing an observed release to the air migration pathway. Contamination via air migration is a concern to the Cove community, but the data necessary to document an observed release to air are absent. As such, the air migration pathway will not be scored as part of this HRS package.

HRS DOCUMENTATION RECORD

Name of Site:	Lukachukai Mountains Mining District (LMMD)	Date Prepared: March 2023
USEPA Region:	9	
Street Address of Site*:	Unincorporated areas of Cove, Round Rock, and Lukachukai Chapters of the Navajo Nation	
City, County, State:	Cove, Apache County, Arizona 86544	
General Location in the State:	The LMMD site is located in the Cove, Round Rock, and Lukachukai Chapters of the Navajo Nation in Apache County in northeast Arizona. The Lukachukai Mountains comprise the northern portion of the Chuska Mountain Range. (Figure 1).	

Latitude*: 36° 33' 30.0" north or 36.558335 north

Longitude*: 109° 13' 03.8" west or -109.217720 west

Latitude and longitude coordinates were measured at the approximate former location of the Cove Transfer Station, which is now the location of an elevated water tank for the Cove community (Ref. 44, pp.18,26).

* The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area where the site is located. They represent one or more locations the United States Environmental Protection Agency (USEPA) considers to be part of the site based on the screening information USEPA used to evaluate the site for NPL listing. USEPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release and not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, disposed, or placed, or has otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Accordingly, USEPA assumes that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

Pathway	
Air Migration Pathway	NS
Ground Water[1] Migration Pathway	NS
Soil Exposure and Subsurface Intrusion Pathway	100.00
Surface Water Migration Pathway	NS
HRS Site Score	**50.00**

NS – Not Scored

[1] "Ground water" and "groundwater" are synonymous; the spelling is different because "ground water" was codified as part of the HRS while "groundwater" is the modern spelling.

WORKSHEET FOR COMPUTING HRS SITE SCORE

	S Pathway	S^2 Pathway
Ground Water Migration Pathway Score (S_{gw})	NS	NS
Surface Water Migration Pathway Score (S_{sw})	NS	NS
Soil Exposure and Subsurface Intrusion Pathway Score (S_{sessi})	100.00	10,000
Air Migration Pathway Score (S_a)	NS	NS
$S_{gw}^2 + S_{sw}^2 + S_{sessi}^2 + S_a^2$		10,000
$(S_{gw}^2 + S_{sw}^2 + S_{sessi}^2 + S_a^2) / 4$		2,500
HRS Site Score $\sqrt{(S_{gw}^2 + S_{sw}^2 + S_{sessi}^2 + S_a^2) / 4}$		50.00

Notes:
HRS Hazard Ranking System
NS Not scored

TABLE 5-1
SOIL EXPOSURE COMPONENT SCORESHEET

Factor Categories and Factors	Maximum Value	Value Assigned
Resident Population Threat		
Likelihood of Exposure:		
1. Likelihood of Exposure:	550	550
Waste Characteristics:		
2. Toxicity	[a]	10,000
3. Hazardous Waste Quantity	[a]	10,000
4. Waste Characteristics	100	100
Targets:		
5. Resident Individual	50	50
6. Resident Population:		
6a. Level I Concentrations	[b]	440
6b. Level II Concentrations	[b]	0
6c. Resident Population (lines 6a + 6b)	[b]	440
7. Workers	15	5
8. Resources	5	0
9. Terrestrial Sensitive Environments	[c]	90
10. Targets (lines 5 + 6c + 7 + 8 + 9)	[b]	585
Resident Population Threat Score:		
11. Resident Population Threat (lines 1 x 4 x 10)	[b]	32,175,000
Nearby Population Threat		
Likelihood of Exposure		
12. Attractiveness/Accessibility	100	Not Scored
13. Area of Contamination	100	Not Scored
14. Likelihood of Exposure	500	Not Scored
Waste Characteristics:		
15. Toxicity	[a]	Not Scored
16. Hazardous Waste Quantity	[a]	Not Scored
17. Waste Characteristics	100	Not Scored
Targets:		
18. Nearby Individual	1	Not Scored
19. Population Within 1 Mile	[b]	Not Scored
20. Targets (lines 18 + 19)	[b]	Not Scored
Nearby Population Threat Score:		
21. Nearby Population Threat (lines 14 x 17 x 20)	[b]	0
SOIL EXPOSURE COMPONENT SCORE		
22. Soil Exposure Component Score[d] (S_{se}) (lines [11 + 21] / 82,500, subject to maximum of 100)	100	100

Notes:
[a] Maximum value applies to waste characteristics category.
[b] Maximum value not applicable.
[c] No specific maximum value applies to factor. However, the pathway score based solely on terrestrial sensitive environments is limited to a maximum of 60.
[d] Do not round to nearest integer.

REFERENCES

Ref. No.	Description of the Reference
1.	U.S. Environmental Protection Agency (EPA). Hazard Ranking System, Title 40 Code of Federal Regulations (CFR) Part 300, Appendix A (55 Federal Register [FR] 51583, Dec. 14, 1990, as amended at 82 FR 2779, Jan. 9, 2017; 83 FR 38037, Aug. 3, 2018), as published in the Code of Federal Regulations on July 1, 2019, with two attachments. Attachment A: Federal Register Vol. 55, No. 241. December 14, 1990. Hazard Ranking System Preamble. Attachment B: Federal Register Vol. 82, No. 5, January 9, 2017. Addition of a Subsurface Intrusion Component to the Hazard Ranking System Preamble. 197 Pages.
2.	USEPA. 2022. Superfund Chemical Data Matrix (SCDM). Online query of SCDM. Query accessed on 8-21-2022. https://www.epa.gov/superfund/superfund-chemical-data-matrix-scdm-query. 21 pages.
3.	Tetra Tech, Inc. (Tetra Tech). 2019. Northern Agency Tronox Mines. "Final - Appendix H3: Site-Specific Removal Site Evaluation Report: Mesa I Mine 10 (M3)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 199 pages.
4.	Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H4: Site-Specific Removal Site Evaluation Report: Mesa I Mine 11 (M4)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 234 pages.
5.	Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H5: Site-Specific Removal Site Evaluation Report: Mesa I Mine 12 (M5)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 252 pages.
6.	Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H6: Site-Specific Removal Site Evaluation Report: Mesa I Mine 13 (M6)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 275 pages.
7.	Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H7: Site-Specific Removal Site Evaluation Report: Mesa I Mine 14 (M7)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 239 pages.
8.	Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H8: Site-Specific Removal Site Evaluation Report: Mesa I Mine 15 (M8)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 247 pages.
9.	Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H9: Site-Specific Removal Site Evaluation Report: Mesa I 1/4 Mine (M9)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 186 pages.
10.	Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H10: Site-Specific Removal Site Evaluation Report: Mesa I 1/2 Mine (M10)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 184 pages.
11.	Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H11: Site-Specific Removal Site Evaluation Report: Henry Phillips Mine (M11)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 187 pages.

12. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H12: Site-Specific Removal Site Evaluation Report: Mesa I 1/2 West Mine (M12).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 186 pages.

13. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H13: Site-Specific Removal Site Evaluation Report: Mesa VI Mine (M13).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 223 pages.

14. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H14: Site-Specific Removal Site Evaluation Report: Frank Jr. Mine (M14).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 205 pages.

15. Tetra Tech. Northern Agency Tronox Mines. “Final - Appendix H15: Site-Specific Removal Site Evaluation Report: Mesa V Incline (M15).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 220 pages.

16. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H16: Site-Specific Removal Site Evaluation Report: Mesa V Adit (M16).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 233 pages.

17. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H17: Site-Specific Removal Site Evaluation Report: Mesa V Mine – 103 (M17).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 237 pages.

18. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H18: Site-Specific Removal Site Evaluation Report: Mesa V Mine – 508 (M18).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 234 pages.

19. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H19: Site-Specific Removal Site Evaluation Report: Mesa IV 1/2 Mine and Simpson 181 (M19).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 203 pages.

20. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H20: Site-Specific Removal Site Evaluation Report: Mesa IV, Mine No. 1 (M20).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 259 pages.

21. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H21: Site-Specific Removal Site Evaluation Report: Mesa IV, Mine No. 2 (M21).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 300 pages.

22. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H22: Site-Specific Removal Site Evaluation Report: Mesa IV, Mine No. 3 (M22).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 198 pages.

23. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H23: Site-Specific Removal Site Evaluation Report: Mesa IV, West Mine (M23).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 204 pages.

24. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H24: Site-Specific Removal Site Evaluation Report: Mesa II Pit (M24).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 225 pages.

25. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H25: Site-Specific Removal Site Evaluation Report: Mesa I 3/4 Incline (M25).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. July 26. 196 pages.

26. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H26: Site-Specific Removal Site Evaluation Report: Mesa I 3/4, Mine No. 2, P-150 (M26).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 185 pages.

27. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H27: Site-Specific Removal Site Evaluation Report: Mesa II, Mine No. 1 & 2, P-21 (M27).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 231 pages.

28. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H28: Site-Specific Removal Site Evaluation Report: Mesa II, Mine No. 1, P-150 (M28).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 219 pages.

29. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H29: Site-Specific Removal Site Evaluation Report: Mesa II, Mine 4 (M29).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-023. Task Order 0001. October 10. 191 pages.

30. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H30: Site-Specific Removal Site Evaluation Report: Mesa II 1/2 Mine (M30).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 233 pages.

31. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H31: Site-Specific Removal Site Evaluation Report: Mesa II 1/2, Mine 4 (M31).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 193 pages.

32. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H32: Site-Specific Removal Site Evaluation Report: Mesa III Mine (M32).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 220 pages.

33. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H33: Site-Specific Removal Site Evaluation Report: Knife Edge Mesa Mine (M33).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 196 pages.

34. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H34: Site-Specific Removal Site Evaluation Report: Black No. 1 Mine (M34).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 205 pages.

35. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Appendix H35: Site-Specific Removal Site Evaluation Report: Black No. 2 Mine (M35).” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 182 pages.

36. Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H36: Site-Specific Removal Site Evaluation Report: Black No. 2 Mine (West) (M36)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 190 pages.

37. Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H37: Site-Specific Removal Site Evaluation Report: Flag No. 1 Mine (M37)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 190 pages.

38. Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H38: Site-Specific Removal Site Evaluation Report: Step Mesa Mine (M38)." = Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 184 pages.

39. Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H39: Site-Specific Removal Site Evaluation Report: Tommy James Mine (M39)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 001. October 10. 26 pages.

40. Tetra Tech. 2019. Northern Agency Tronox Mines "Final - Appendix H40: Site-Specific Removal Site Evaluation Report: Cove Transfer Station (M40)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 285 pages.

41. Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H41: Site-Specific Removal Site Evaluation Report: Mesa I Camp (T17)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 407 pages.

42. Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix H42: Site-Specific Removal Site Evaluation Report: NA-0344B (T23)." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 205 pages.

43. Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix A: Background Investigation Report." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 7,164 pages.

44. Ecology & Environment, Inc. (E&E). 2013. "Cove Transfer Station Sites 1 and 2, Abandoned Uranium Mine Waste Removal Action Report. Navajo Nation, Cove Chapter, Apache Country, Arizona." Prepared for USEPA Emergency Response Section, Region 9. February. 365 pages.

45. E&E. 2012. "Cove Transfer Station Sites 1 and 2, Abandoned Uranium Mine Waste Removal Assessment Report." Prepared for USEPA Emergency Response Section, Region 9. February. 141 pages.

46. Weston Solutions, Inc. (Weston). 2010. "Navajo Abandoned Uranium Mine (AUM) Northern Region Site Screen Report – NA-0319 AUM Site." Prepared for EPA under Contract No. W91238-06-F-0083. March. 18 pages.

47. Weston. 2010. "Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Cov068 AUM Site." Prepared for USEPA under Contract No. W91238-06-F-0083. March. 11 pages.

48. EPA. 2022. "Using Qualified Data to Document an Observed Release and Observed Contamination." Quick Reference Fact Sheet. USEPA Directive 9285.7-89FS. November. 20 pages.

49. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – NA-0343 AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 11 pages.

50. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Mesa IV, East Side AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 11 pages.

51. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – NA-0313 AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 11 pages.

52. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Cov000 AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 10 pages.

53. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Cov087 Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 11 pages.

54. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – NA-0318 AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 11 pages.

55. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Cato No. 1 Pit AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 12 pages.

56. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Cove Mesa Mines (Cato Sells) AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 24 pages.

57. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – West Mesa Mine AUM Site.” Prepared for EPA under Contract No. W91238-06-F-0083. March. 12 pages.

58. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – East Mesa Mines AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 11 pages.

59. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Cove Mesa Mines (AEC Plot 7) AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 63 pages.

60. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – NA-0332 AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 10 pages.

61. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – NA-0333 AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 10 pages.

62. Tetra Tech. 2019. Northern Agency Tronox Mines. “Final - Removal Site Evaluation Report.” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 342 pages.

63. Jacobs, Inc. (Jacobs). 2022. “Cove Mine Sites Removal Site Evaluation Report.” Final. Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 92 pages.

64. Weston. 2014. “Site Reassessment Mesa I, Mines 10-15 Abandoned Uranium Mine.” Prepared for USEPA under Contract No. W91238-11-D-001. January. 72 pages.

65. Neptune and Company, Inc. and TerraSpectra Geomatics. 2018. “Cove Chapter Abandoned Uranium Mines, Final Preliminary Conceptual Site Model.” July. 251 pages.

66. EPA Project Note Regarding Lukachukai Mountains – Particular Area, Relatively Small in Size, Important to Maintenance of a Unique Biotic Community. 2022. From EPA Kenyon Larsen, Remedial Project Manager, and Cove Chapter President James Benally. July 20. 1 page.

67. EPA Project Note Regarding Lukachukai Mountains – Terrestrial Breeding Area for Large or Dense Aggregation of Vertebrates. 2022. From EPA Kenyon Larsen, Remedial Project Manager, and Cove Chapter President James Benally. July 20. 1 page.

68. Navajo Nation Division of Natural Resources Department of Fish and Wildlife. 2020. “Navajo Endangered Species List.” Resources Committee Resolution No. RDCJA-01-20. February 13. 4 pages.

69. United States Fish and Wildlife Service (USFWS). 2022. “List of Species Believed to or Known to Occur in Arizona.” Environmental Conservation Online System. Accessed August 21. https://ecos.fws.gov/ecp/report/species-listings-by-state?stateAbbrev=AZ&stateName=Arizona&statusCategory=Listed. 10 pages.

70. EPA Project Note Regarding the Number of Students and Workers at the Cove Day School. 2022. From EPA Jesse Kass and Kenyon Larsen, Remedial Project Managers, and Cove Day School Head Teacher/Administrator Willeen J. Benally. September 2. 1 page.

71. TerraSpectra Geomatics. 2007. “Abandoned Uranium Mines and the Navajo Nation, Navajo Nation AUM Screening Assessment Report and Atlas with Geospatial Data.” August. 198 pages.

72. Tetra Tech. 2020.Northern Agency Tronox Mines. Engineering Evaluation/Cost Analysis “Mexican Spotted Owl Survey Report 2019 Nesting Season.” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0016. October 16. 125 pages.

73. Tetra Tech. 2022. “Preliminary Assessment Report. Lukachukai Mountains Mining District.” Contract No. EP-S9-17-03. October 30. 2,157 pages.

74. New Order Environmental Services, LLC. Bureau of Indian Affairs (BIA), Division of Facilities Management and Construction (DFMC). 2019. “Radiological Testing Gamma Walkover Services, Cove Day School, Red Valley, Arizona.” October 25. 22 pages.

75. Jacobs. 2022. “Appendix A-1: Cato No. 2 Mine Site.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 45 pages.

76. Jacobs. 2022. “Appendix A-2: Frank No. 1 Mine Site.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 95 pages.

77. Jacobs. 2022. “Appendix A-3: Frank No. 2 Mine Site.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 41 pages.

78. Jacobs. 2022. “Appendix A-4: NA-0316 Mine Site.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 40 pages.

79. Jacobs. 2022. “Appendix A-5: Mesa IV 1/4 Mine Site.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 44 pages.

80. Jacobs. 2022. “Appendix A-6: Mesa III Northwest Mine Site.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 39 pages.

81. Jacobs. 2022. “Appendix A-7: Mesa III West Mine Site.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 43 pages.

82. Jacobs. 2022. “Appendix A-8: Mesa II 1/4 Mine Site.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 41 pages.

83. Jacobs. 2022. “Appendix A-9: Billy Topaha Mine Site.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 44 pages.

84. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809426 and 1809427.” April 9. 187 pages.

85. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1806221 and 1806236.” January 24. 167 pages.

86. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1807369, 1807370, and 1809587.” February 27. 116 pages.

87. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809428 and 1809429.” April 5. 188 pages.

88. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1807350 and 1807351.” February 11. 166 pages.

89. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805321 and 1805322.” October 18. 173 pages.

90. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805319 and 1805320.” October 16. 172 pages.

91. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1810124 and 1810125.” In “Data Validation Report.” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. April 17. 371 pages.

92. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1810126 and 1810127.” April 17. 145 pages.

93. Tetra Tech. 2022. “Lukachukai Mountain Mining District Hazard Ranking System Site Investigation Field Sampling Plan. Response, Assessment, and Evaluation Services.” July 18. 97 pages.

94. Reference No. Reserved

95. Reference No. Reserved

96. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1808356 and 1808360.” February 19. 111 pages.

97. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1810076 and 1810077.” April 15. 230 pages.

98. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1810026 and 1810027.” April 17. 281 pages.

99. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1808483 and 1808484.” February 19. 121 pages.

100. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1807264 and 1807265.” January 30. 185 pages.

101. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1810079 and 1810080.” April 17. 313 pages.

102. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1807353 and 1807354.” February 12. 175 pages.

103. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809355 and 1809356.” April 3. 139 pages.

104. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805630 and 1805631.” January 24. 172 pages.

105. Reference No. Reserved

106. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1806626 and 1806627.” January 11. 168 pages.

107. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805626 and 1805627.” December 18. 171 pages.

108. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805589 and 1805592.” November 19. 113 pages.

109. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809298 and 1809299.” April 1. 189 pages.

110. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809365 and 1809366.” April 2. 124 pages.

111. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1806222 and 1806235.” January 24. 165 pages.

112. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1806157 and 1806158.” December 7. 172 pages.

113. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809349 and 1809351.” April 2. 141 pages.

114. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805628 and 1805629.” November 30. 171 pages.

115. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805632 and 1805633.” December 5. 60 pages.

116. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809477 and 1809478.” April 12. 248 pages.

117. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1807365 and 1807366.” January 8. 163 pages.

118. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1806159 and 1806160.” December 7. 172 pages.

119. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809283 and 1809284.” March 26. 151 pages.

120. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809473 and 1809474.” March 11. 186 pages.

121. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809424 and 1809425.” April 9. 103 pages.

122. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1806224 and 1806234.” January 24. 105 pages.

123. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809475 and 1809476.” April 2. 210 pages.

124. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1806311 and 1806312.” December 18. 53 pages.

125. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1806161 and 1806162.” December 18. 173 pages.

126. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1807262 and 1807263.” January 30. 175 pages.

127. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1807369, 1807370 and 1809587.” February 27. 116 pages.

128. Reference No. Reserved

129. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1810024 and 1810025.” April 17. 283 pages.

130. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1810072 and 1810073.” April 17. 196 pages.

131. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805317 and 1805318.” October 16. 171 pages.

132. Reference No. Reserved

133. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1810032 and 1810033.” April 12. 104 pages.

134. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1808302 and 1808303.” February 19. 111 pages.

135. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1807325 and 1807326.” February 11. 176 pages.

136. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809418 and 1809419.” April 12. 150 pages.

137. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1807330 and 1807331.” January 4. 209 pages.

138. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1807357 and 1807358.” February 13. 162 pages.

139. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805035 and 1805036.” October 12. 109 pages.

140. Jacobs. 2020. “Appendix E-1: Site-Specific Laboratory Reports Cato No. 2.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. May 8. 1,547 pages.

141. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805581 and 1805582.” November 1. 99 pages.

142. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805586 and 1805587.” November 6. 99 pages.

143. Reference No. Reserved

144. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1810001 and 1810002.” April 12. 144 pages.

145. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805323 and 1805324.” October 18. 172 pages.

146. Reference No. Reserved

147. Reference No. Reserved

148. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805038 and 1805039.” October 12. 112 pages.

149. Jacobs. 2020. “Appendix E-2: Site-Specific Laboratory Reports Frank No. 1.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. May 8. 5,158 pages.

150. Tetra Tech. 2018. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1805042 and 1805043.” October 15. 74 pages.

151. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809412 and 1809413.” April 12. 151 pages.

152. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1808494 and 1808495.” March 11. 21 pages.

153. Reference No. Reserved

154. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809479and 1809480.” April 1. 302 pages.

155. Reference No. Reserved

156. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1809453 and 1809454.” April 5. 160 pages.

157. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1808475 and 1808476.” February 19. 93 pages.

158. Tetra Tech. 2019. “Data Validation Report. Response, Assessment, and Evaluation Services. Task Order 0001. Contract No. EP-S9-17-03. Laboratory Report Nos. 1810003 and 1810004.” April 15. 130 pages.

159. Reference No. Reserved

160. Reference No. Reserved

161. Reference No. Reserved

162. Jacobs. 2020. “Appendix E-3: Site-Specific Laboratory Reports Frank No. 2.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. May 8. 1,830 pages.

163. Jacobs. 2020. “Appendix E-4: Site-Specific Laboratory Reports NA-0316.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. May 8. 1,721 pages.

164. Jacobs. 2020. “Appendix E-5: Site-Specific Laboratory Reports Mesa IV 1/4.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. May 8. 2,306 pages.

165. Jacobs. 2020. “Appendix E-6: Site-Specific Laboratory Reports Mesa III Northwest.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. May 8. 1,540 pages.

166. Jacobs. 2020. “Appendix E-7: Site-Specific Laboratory Reports Mesa III West.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. May 8. 770 pages.

167. Jacobs. 2020. “Appendix E-8: Site-Specific Laboratory Reports Mesa II 1/4.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. May 8. 2,476 pages.

168. Jacobs. 2020. “Appendix E-9: Site-Specific Laboratory Reports Billy Topaha.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. May 8. 1,624 pages.

169. Jacobs. 2020. “Appendix E: Background Laboratory Reports.” In “Cove Mine Sites Removal Sites Evaluation Report.” Prepared for the Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. May 8. 2,008 pages.

170. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Jimmie King No. 9 Mine AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 10 pages.

171. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Joleo Mine AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 13 pages.

172. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Cisco Mine AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 12 pages.

173. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Camp Mine AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 12 pages.

174. Validata Chemical Services, Inc. 2022. Data Validation Summary Report – Radiochemistry. Response, Assessment, and Evaluation Services. TO16-Northern Agency Tronox Mines SDG No. 2207534. August 4. 36 pages.

175. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Cove Mesa Mines (AEC Plot 7).” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 63 pages.

176. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Mexican Cry Mines.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 14 pages.

177. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Hall Mine AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 15 pages.

178. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Nakai Chee Begay AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 11 pages.

179. Weston. 2010. “Navajo Abandoned Uranium Mine Northern Region Site Screen Report – Tom Joe No. 6 AUM Site.” Prepared for USEPA under Contract No. W91238-06-F-0083. March. 12 pages.

180. Reference No. Reserved

181. Reference No. Reserved

182. Reference No. Reserved

183. Tetra Tech. 2020. Northern Agency Tronox Mines. “Tommy James Mine Site-Specific Removal Site Evaluation Technical Memorandum.” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0016. January 8. 688 pages.

184. ALS Environmental Laboratories. 2022. “Gamma Spectroscopy Case Narrative - LMMD HRS Site Investigation. Work Order Number: 2207535.” August 18. 506 pages.

185. Reference No. Reserved

186. Tetra Tech Project Note with Attachments. 2022. Subject: Knife Edge Mesa Complex Radium-226 and Metals Results from 2022 Sampling. Attachments: ALS Environmental Laboratories Analytical Results Report, Knife Edge Complex Photo Log, and Field Notes. September 15. 681 pages.

187. Chenoweth, W.L. 1988. Arizona Geological Survey Open-File Report 88-19. “The Geology and Production History of the Uranium-Vanadium Deposits in the Lukachukai Mountains, Apache County Arizona.” September. 69 pages.

188. Stokes, W.L. 1951. United States Department of the Interior Geological Survey Circular 111. “Carnotite Deposits in the Carrizo Mountains Area, Navajo Indian Reservation, Apache County, Arizona, and San Juan County, New Mexico.” May. 7 pages.

189. Dare, W.L. 1961. United States Department of the Interior Bureau of Mines, Information Circular 8011. “Uranium Mining in the Lukachukai Mountains, Apache County, Ariz., Kerr-McGee Oil Industries, Inc.” TN23.U71 No. 8011. 42 pages.

190. Reference No. Reserved

191. Navajo Nation Division of Natural Resources Reclamation Department. 1991. “Environmental Assessment Cove Abandoned Mine Lands Project.” NC-0300, -0301, -0302, -0303. April. 49 pages.

192. Clifford, A. 2015. Carrizo Mountain Environmental & Herbarium, Inc. “Biologic Baseline Data, Geology of the Cove Region Apache County, Arizona.” Prepared for USEPA Superfund Division and Cove Community Chapter. May. 58 pages.

193. Kosatka, R. F. 1956. U.S. Atomic Energy Commission. Grand Junction Operations Office Exploration Division. Summary of Uranium Exploration in the Lukachukai Mountains, Apache County, Arizona 1950-1955: Open-File Report RME-199. March 30. 31 pages.

194. GEL Laboratories LLC. 2022. “NPL LMMD HRS Investigation Analytical Results Report, Work Order: 596484.” October 19. 591 pages.

195. GEL Laboratories LLC. 2022. “NPL LMMD HRS Investigation Analytical Results Report, Work Order: 596516.” October 19. 1,200 pages.

196. GEL Laboratories LLC. 2022. “NPL LMMD HRS Investigation Analytical Results Report, Work Order: 596526.” October 19. 814 pages.

197. GEL Laboratories LLC. 2022. “NPL LMMD HRS Investigation Analytical Results Report, Work Order: 596530.” October 19. 867 pages.

198. Reference No. Reserved

199. U.S. District Court. 2017. Consent Decree. United States of America and Navajo Nation v. Cyprus Amax Minerals Company and Western Nuclear, Inc. District of Arizona. 161 pages.

200. Tetra Tech. 2022. Project Note Regarding Radium-226 Background Statistics. December 6. 3 pages.

201. GEL Laboratories LLC. 2022. "NPL LMMD HRS Investigation Analytical Results Report, Work Order: 596507." November 8. 738 pages

202. GEL Laboratories LLC. 2022. "NPL LMMD HRS Investigation Analytical Results Report, Work Order: 596524." Response, Assessment, and Evaluation Services. November 8. 786 pages

203. GEL Laboratories LLC. 2022. "NPL LMMD HRS Investigation Analytical Results Report, Work Order: 596528." Response, Assessment, and Evaluation Services. November 8. 711 pages

204. GEL Laboratories LLC. 2022. "NPL LMMD HRS Investigation Analytical Results Report, Work Order: 596534." Response, Assessment, and Evaluation Services. November 10. 630 pages

205. Weston. 2018. Final Assessment Report Cove Wash Watershed Assessment Site, Navajo Nation, Cove Chapter, Arizona. April. 574 pages.

206. Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix K: Access Road Report. Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 140 pages.

207. Tetra Tech. 2019. Northern Agency Tronox Mines. "Final - Appendix J: Drainage Investigation Report." Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-03. Task Order 0001. October 10. 451 pages.

208. Dare, W.L. United States Department of the Interior, Bureau of Mines. 1959. "Underground Mining Methods and Costs at Three Salt Wash Uranium Mines of the Climax Uranium Co.". TN23.U71 No. 7908. 39 pages.

209. Gallagher & Kennedy Attorneys at Law. 2008. "Request for Information - Navajo Nation Abandoned Uranium Mine Sites." August 29. 19 pages.

210. Tetra Tech. 2022. Project Note Regarding Lukachukai Mountain Mining District - Mining History. December 23. 4 pages.

211. EPA. 1995. "Establishing Areas of Observed Contamination." Quick Reference Fact Sheet. Office of Solid Waste and Emergency Response Directive 9285.7-18FS. September. 7 pages.

212. Tetra Tech Project Note with Attachments. 2022. Subject: Step Mesa Radium-226 and Metals Results from 2022 Sampling. Attachments: GEL Laboratories LLC Analytical Results Report, Step Mesa Photo Log, and Field Notes. December 2. 3,147 pages.

213. Tetra Tech. Project Note with Attachments. 2022. Subject: Mexican Cry Radium-226 and Metals Results from 2022 Sampling. Attachments: GEL Laboratories LLC Analytical Results Report, Mexican Cry Photo Log, and Field Notes. December 2. 4,867 pages.

214. Tetra Tech. Project Note with Attachments. 2022. Subject: Cove Mesa Radium-226 and Metals Results from 2022 Sampling. Attachments: GEL Laboratories LLC Analytical Results Report, Cove Mesa Photo Log, and Field Notes. December 6. 4,889 pages.

215. U.S. Department of the Interior Office of Surface Mining Reclamation and Enforcement. 2001. “Abandoned Mine Land Problem Area Description NA-0332.”. March. 18 pages.

216. U.S. Department of the Interior Office of Surface Mining Reclamation and Enforcement. 2001. “Abandoned Mine Land Problem Area Description NA-0333.” March. 16 pages.

217. Nez, Johnathan. The Navajo Nation. 2022. "Proposed Listing of the Lukachukai Mountains Mining District on the Superfund NPL." December 22. 2 pages.

218. Jacobs. 2022. "Appendix F: Statistical Documentation." In “Cove Mine Sites Removal Sites Evaluation Report.” Cyprus Amax Minerals Company. Contract No. FES0305201427NWO. October. 314 pages.

219. Weston. 2017. Draft Final Wetland Delineation Report. Cove Wash Watershed Assessment Site. Prepared for EPA under Contract No. EP-S5-13-02. December. 127 pages.

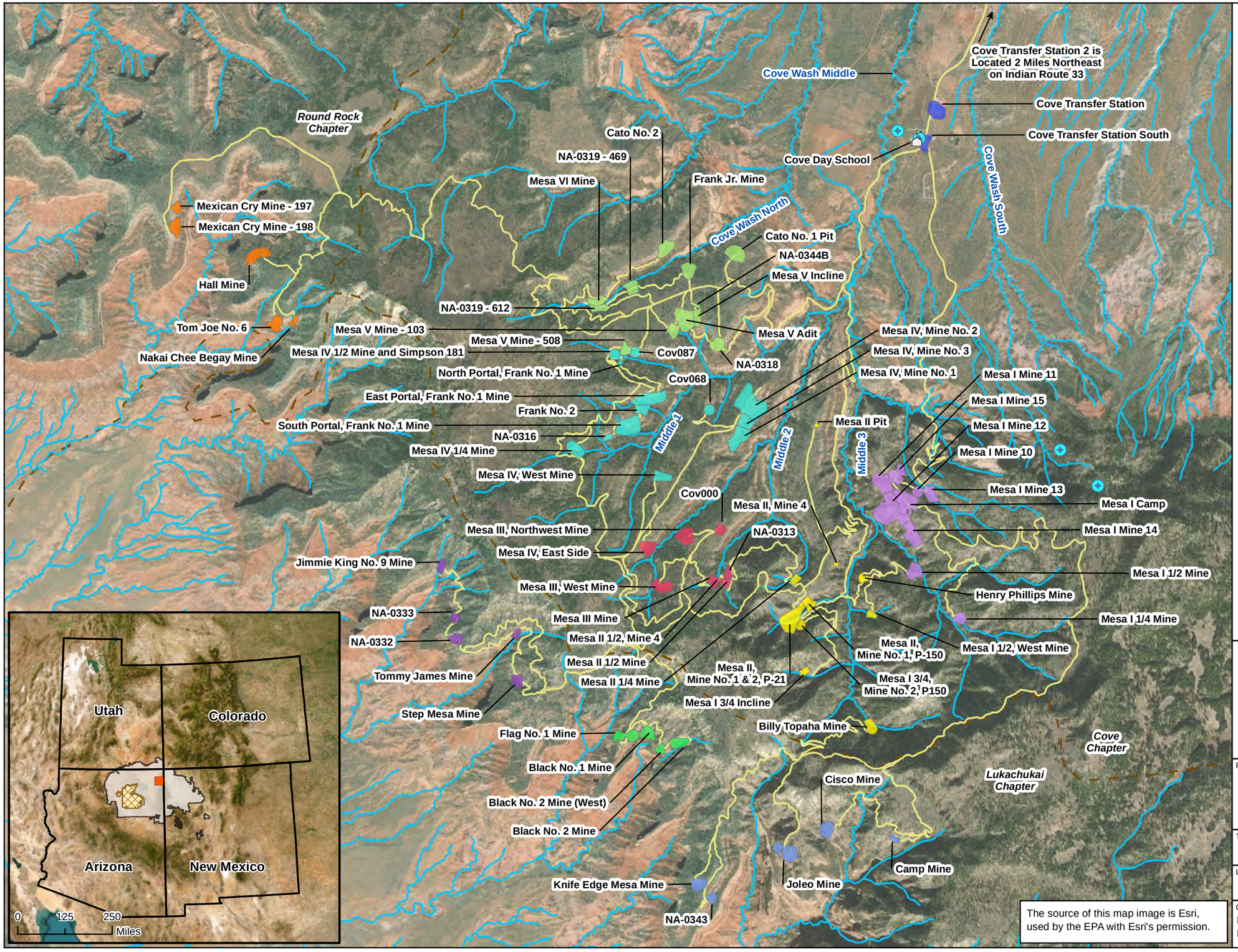
220. Tetra Tech. 2023. Project Note with Attachments. Subject: Removal Site Evaluation Report Chains of Custody. Attachments: Chains of Custody for Soil Samples Collected During the 2018 Northern Agency Tronox Mines Removal Site Evaluation. January 12. 919 pages.

221. Tetra Tech. 2018. “Northern Agency Tronox Mines Removal Site Evaluation Work Plan.” Response, Assessment, and Evaluation Services. Contract No. EP-S9-17-02. Task Order 0001. May 14. 3,816 pages.

222. CH2M HILL Engineers, Inc. 2017. “Removal Site Evaluation Work Plan for Consent Decree Sites”. Prepared for the Cyprus Amax Minerals Company. October. 908 pages.

223. Navajo AML Reclamation Department. Cove 2 AMLR Project. Technical Specifications. Date unknown, but embedded maps are from April 1999. 53 pages.

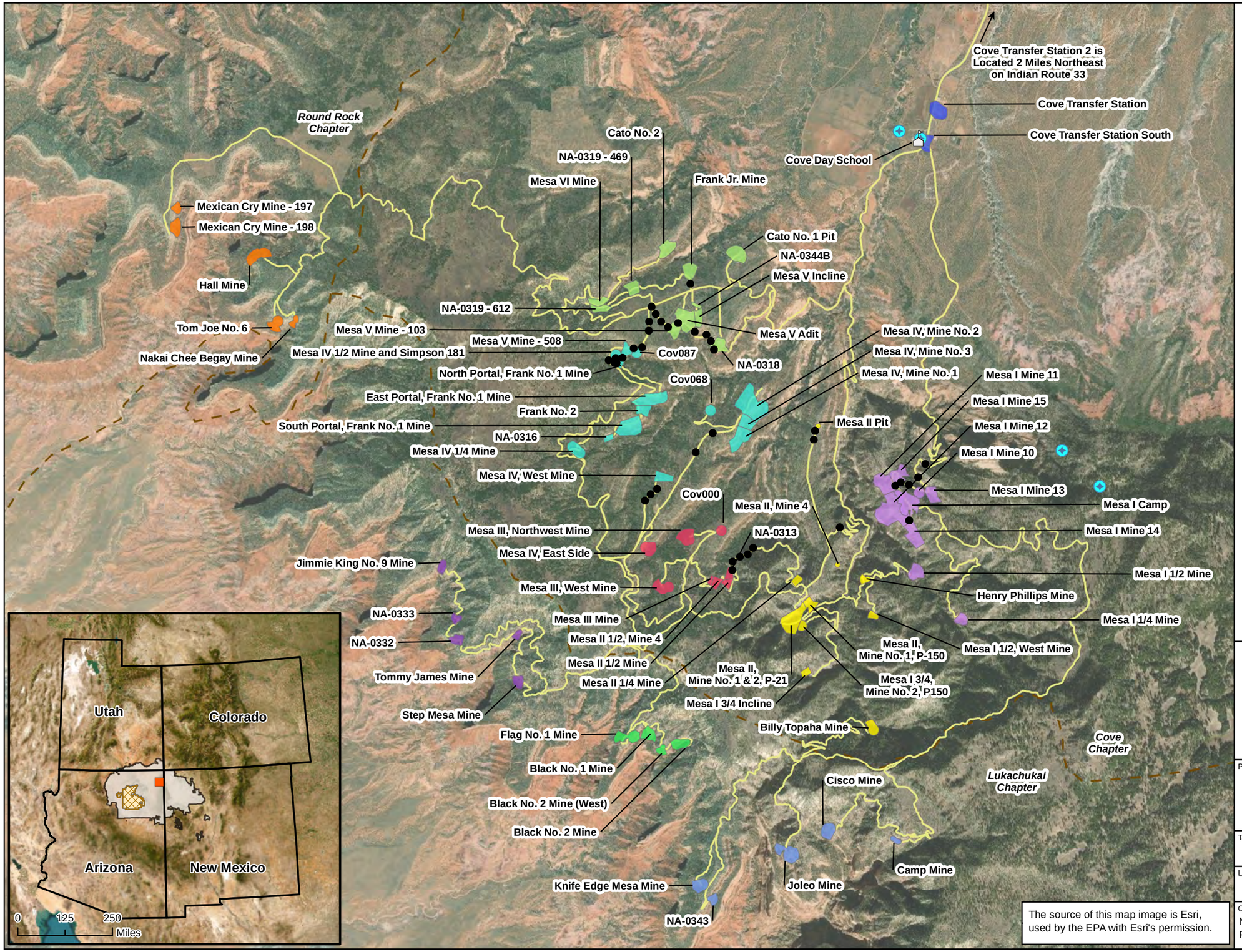
224. U.S. Fish and Wildlife Service, Department of the Interior. 2004. Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat of the Mexican Spotted Owl; Final Rule. Title 50 CFR Part 17, as published in the Federal Register August 31. 118 pages.



LUKACHUKAI MOUNTAINS MINING DISTRICT - COVE, LUKACHUKAI, AND ROUND ROCK CHAPTERS

The source of this map image is Esri, used by the EPA with Esri's permission.

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: NAVAJO NATION	Date: 1/12/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 1



Lukachukai Mountain Mining District

Haul Road Sample Location with Elevated Metals or Radionuclides

Mines / Other Sources[1]

- Cove Transfer Station
- Flag Mesa
- Knife Edge Mesa
- Mesa I
- Mesa II
- Mesa III
- Mesa IV
- Mesa V and VI
- Mexican Cry Mesa
- Step Mesa

Navajo Nation Boundary

Navajo Nation Chapter Boundary

Hopi Reservation

Historic Haul Route

Wash

Well (Domestic Use)

Cove Day School

Note:
[1]Reference 71.

1 inch = 3,400 feet

1:40,800

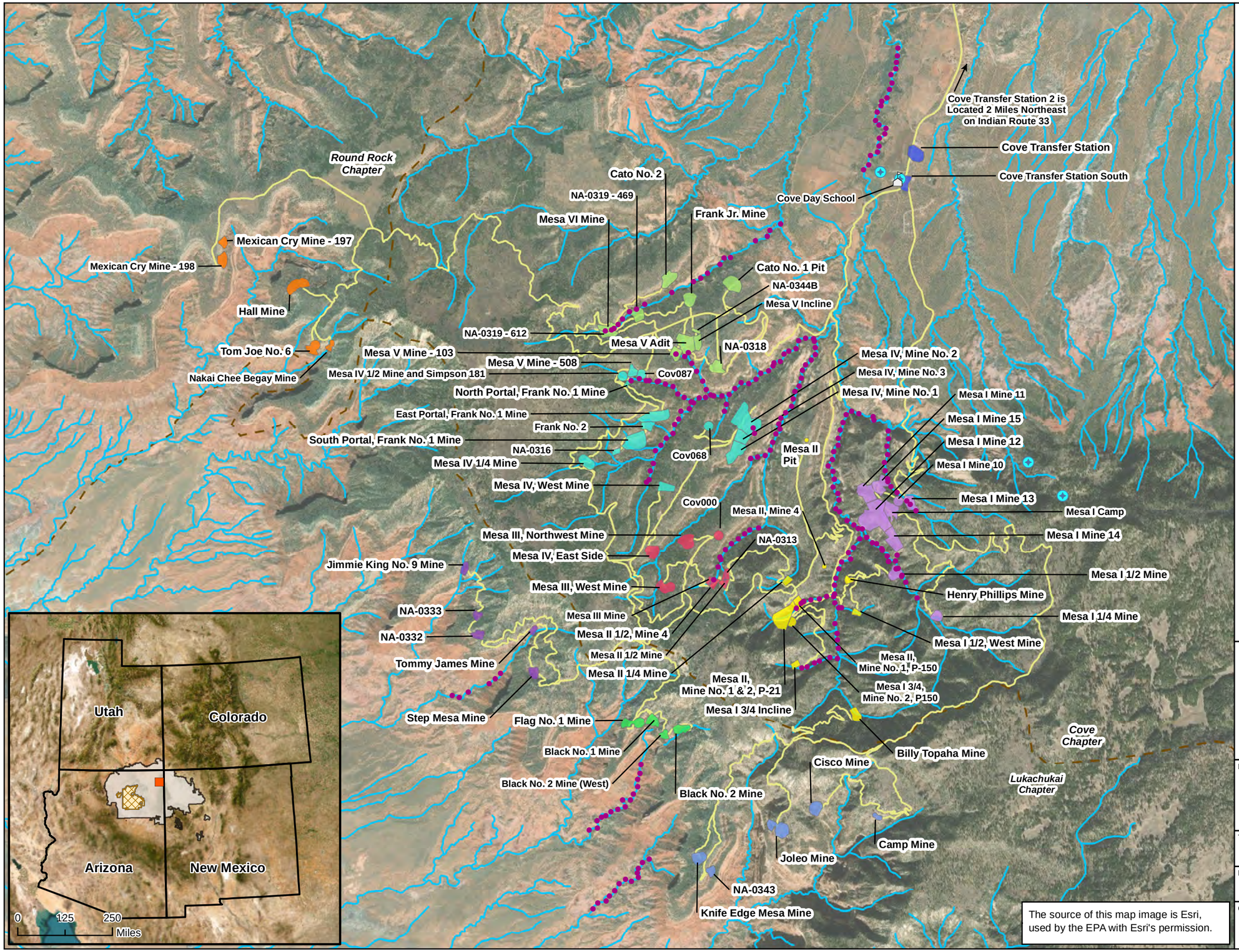
N W E S

3,400 1,700 0 3,400 Feet

LUKACHUKAI MOUNTAINS MINING DISTRICT - MINE ROADS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: NAVAJO NATION	Date: 1/12/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 2

The source of this map image is Esri, used by the EPA with Esri's permission.



Lukachukai Mountain Mining District

Sediment Sample Location with Elevated Metals or Radionuclides

Mines / Other Sources[1]

- Cove Transfer Station
- Flag Mesa
- Knife Edge Mesa
- Mesa I
- Mesa II
- Mesa III
- Mesa VI
- Mesa V and VI
- Mexican Cry Mesa
- Step Mesa

Navajo Nation Boundary

Navajo Nation Chapter Boundary

Hopi Reservation

Historic Haul Route

Wash

Well (Domestic Use)

Cove Day School

Note:
[1]Reference 71.

1 inch = 3,740 feet

1:44,880

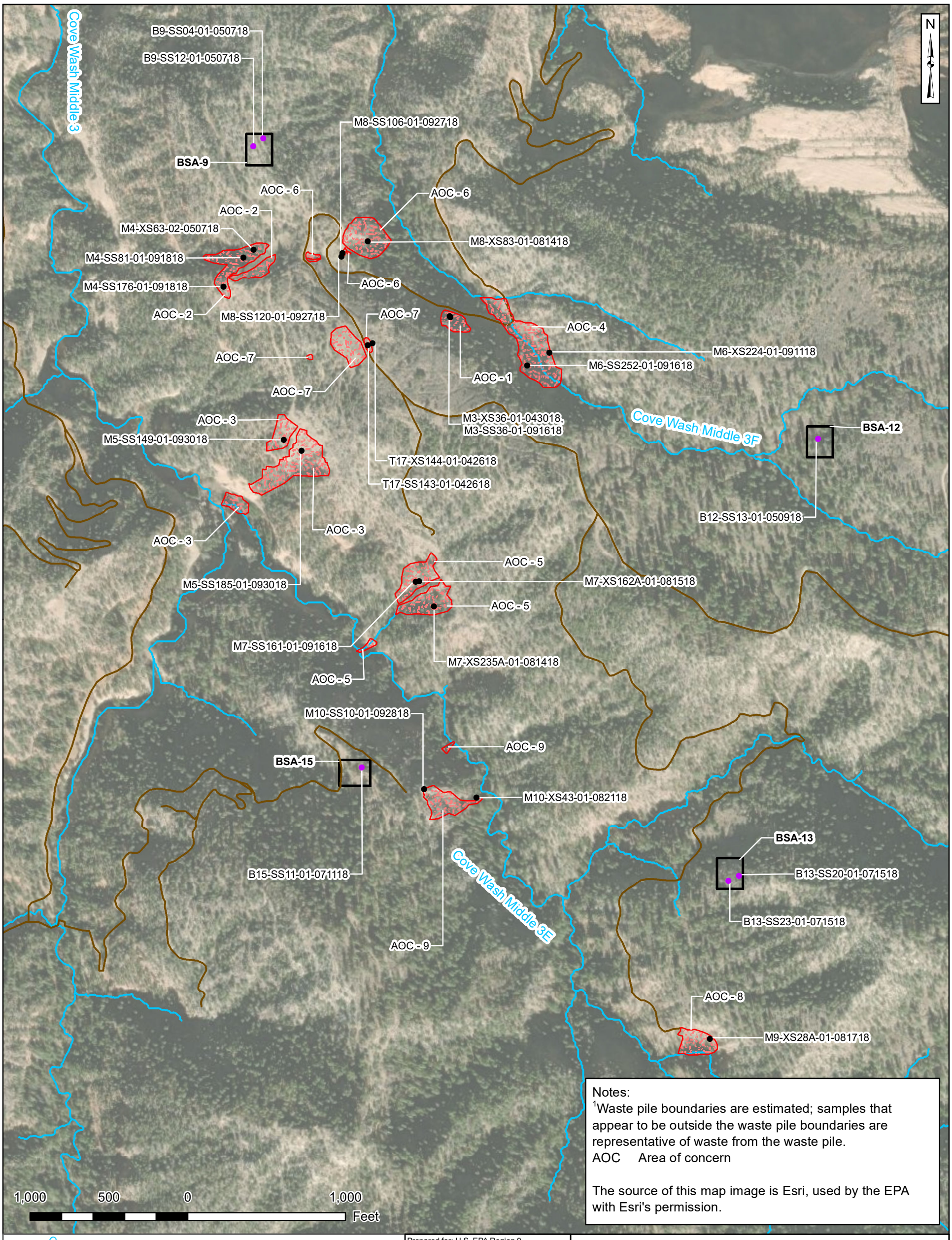
N W E S

3,740 1,870 0 3,740 Feet

LUKACHUKAI MOUNTAINS MINING DISTRICT - SURFACE WATER

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: NAVAJO NATION	Date: 1/12/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 3

The source of this map image is Esri, used by the EPA with Esri's permission.



Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

The source of this map image is Esri, used by the EPA with Esri's permission.

- Waste Sample Location[1]
- Background Surface Soil Sample Location *0-6 inches*
- Waste Pile
- Background Study Area
- Historic Haul Route
- Wash

References:
3, p.145; 4, pp.146-147; 5, p.149; 6, pp. 145, 148; 7, pp.148-149; 8, pp.149, 151, 152; 9, p.140; 41, pp.142, 145; 10, p.138; 43, pp.947, 1263, 1369, 1574.

Prepared for: U.S. EPA Region 9

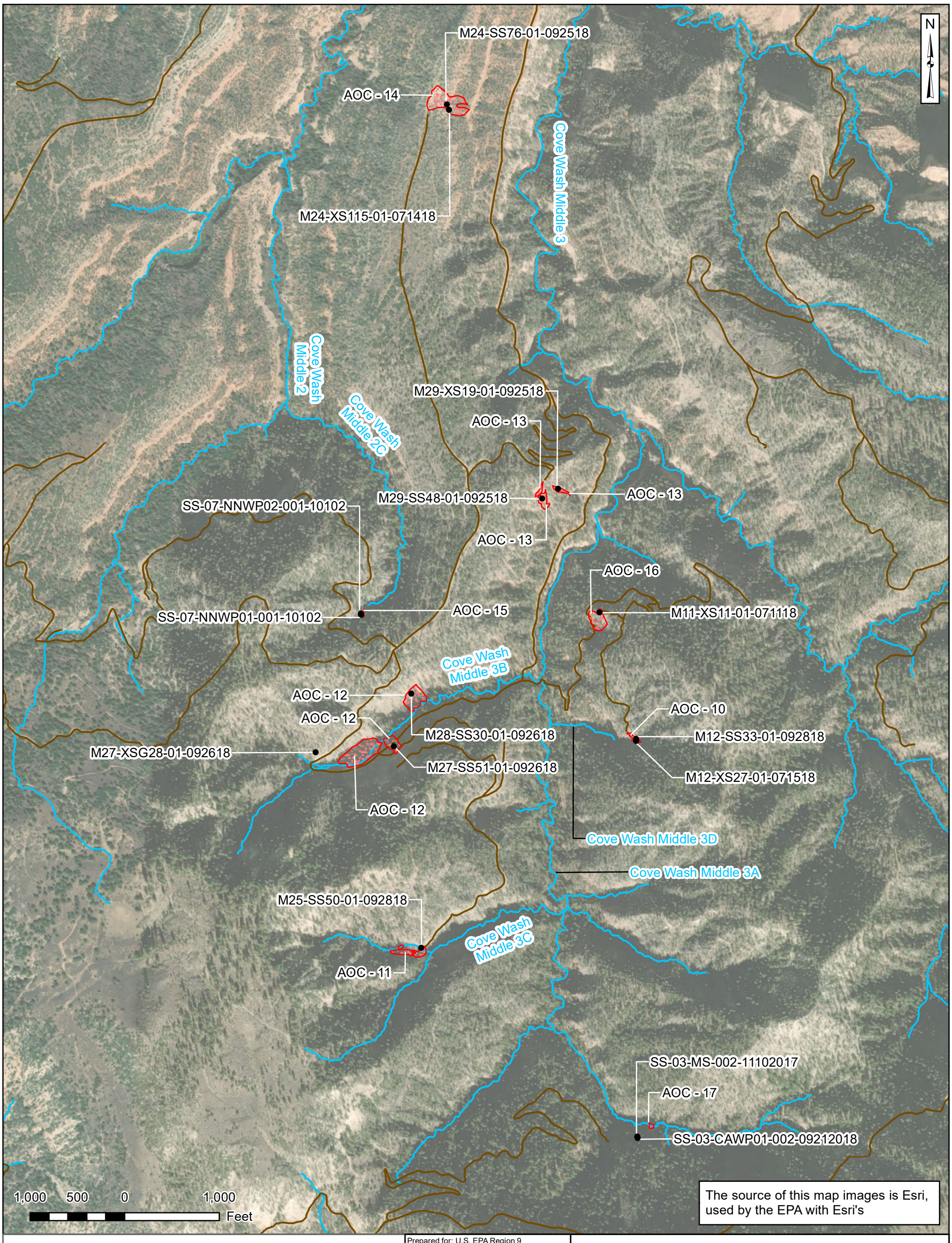
Prepared By:

TETRA TECH
1999 Harrison Street, Suite 500
Oakland, CA 94612

MESA I
BACKGROUND AND
WASTE SAMPLE LOCATIONS

Task Order No.:	Contract No.:	Figure No.:
0016	EP-S9-17-03	4
Location: COVE CHAPTER NAVAJO NATION	Date: 3/7/2023	

Coordinate System:
NAD 1983 State Plane Arizona East FIPS 0201 Feet



- Waste Sample Location[1]
- Waste Pile
- Historic Haul Route
- Wash

Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

References: 12, p.139; 25, p.142; 28, p.138; 27, p.146; 29, p.139; 24, p.143; 82, p.22; 11. p.136; 83, p.22.

Prepared for: U.S. EPA Region 9

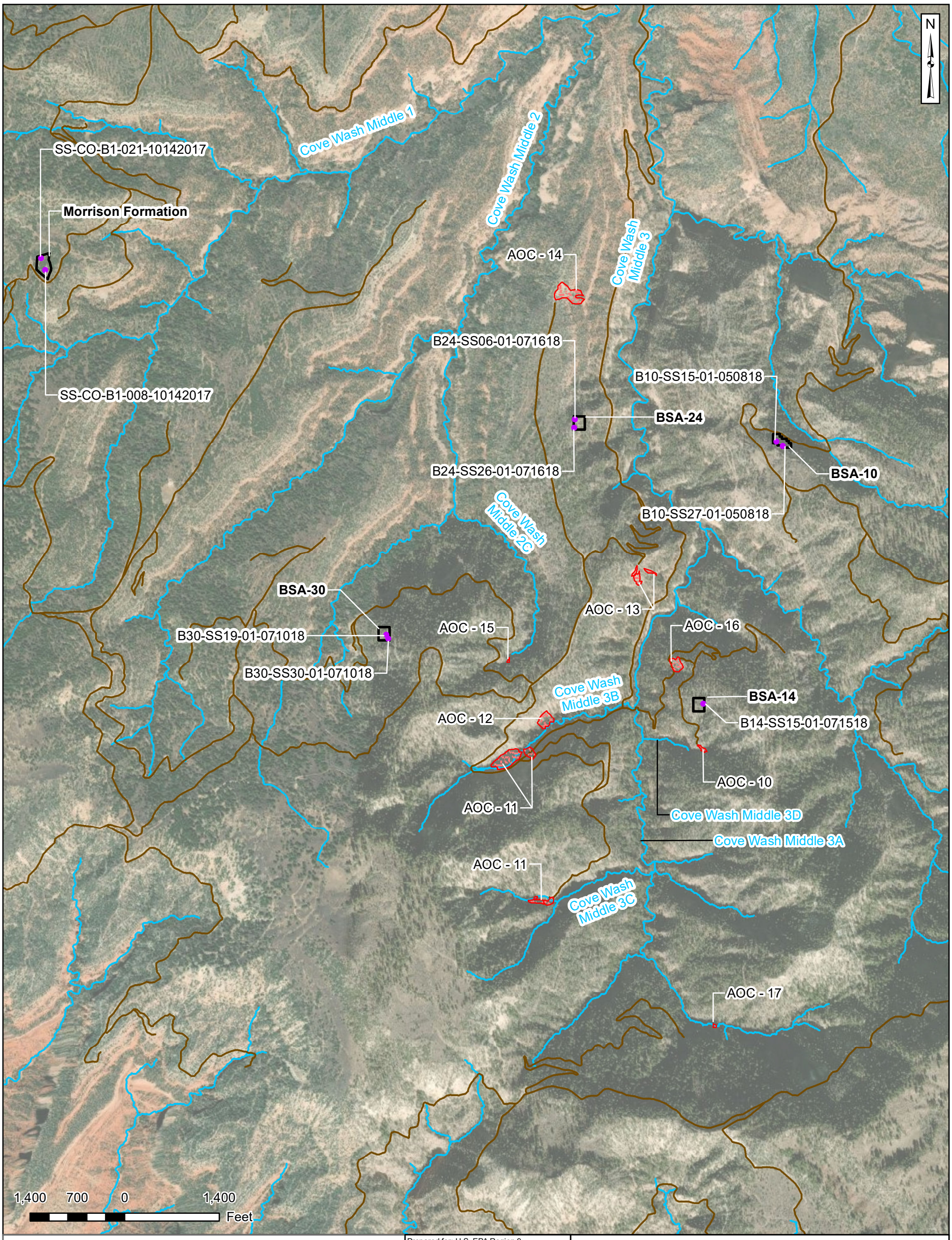
Prepared By:

TETRA TECH
1999 Harrison Street, Suite 500
Oakland, CA 94612

MESA II
WASTE SAMPLE LOCATIONS

Task Order No.:	Contract No.:	Figure No.:
0016	EP-S9-17-03	5
Location: COVE CHAPTER NAVAJO NATION	Date: 3/7/2023	

Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet



Background Surface Soil Sample Location
0-6 inches

Background Study Area (BSA)

Waste Pile

Historic Haul Route

Wash

Note:
AOC Area of concern

References: 43, pp.1053,1470, 2502, 3022; 63, p.64.

The source of this map images is Esri, used by the EPA with Esri's permission.

Prepared for: U.S. EPA Region 9

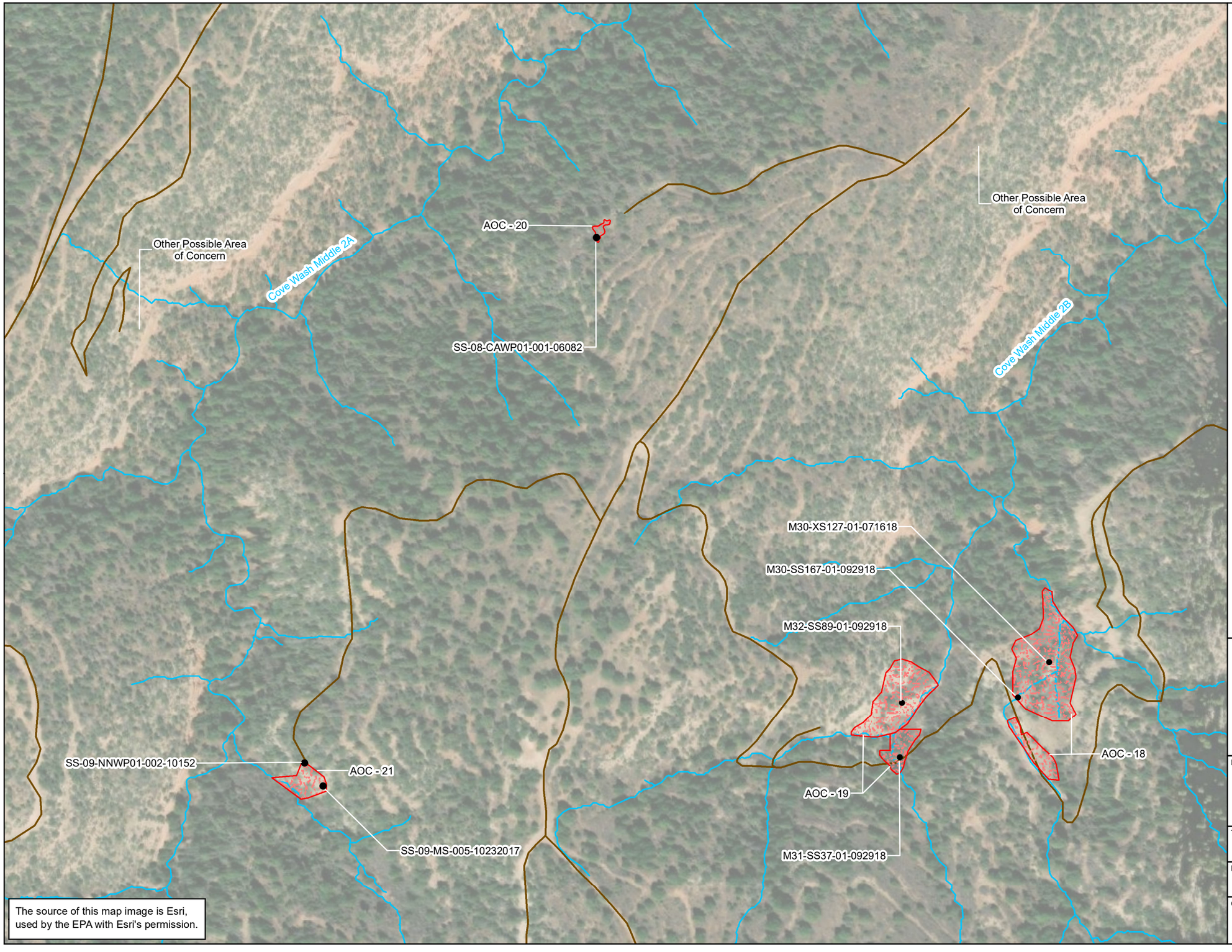
Prepared By:

TETRA TECH
1999 Harrison Street, Suite 500
Oakland, CA 94612

MESA II
BACKGROUND SAMPLE LOCATIONS

Task Order No.:	Contract No.:	Figure No.:
0016	EP-S9-17-03	6
Location: COVE CHAPTER NAVAJO NATION	Date: 3/6/2023	

Coordinate System:
NAD 1983 State Plane Arizona East FIPS 0201 Feet



- Waste Sample Location[1]
- Waste Pile
- Historic Haul Route
- Wash

Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

References: 30, p.143; 31, p.143; 32, p.146; 80, p.20; 81, p.20.

1 inch = 300 feet

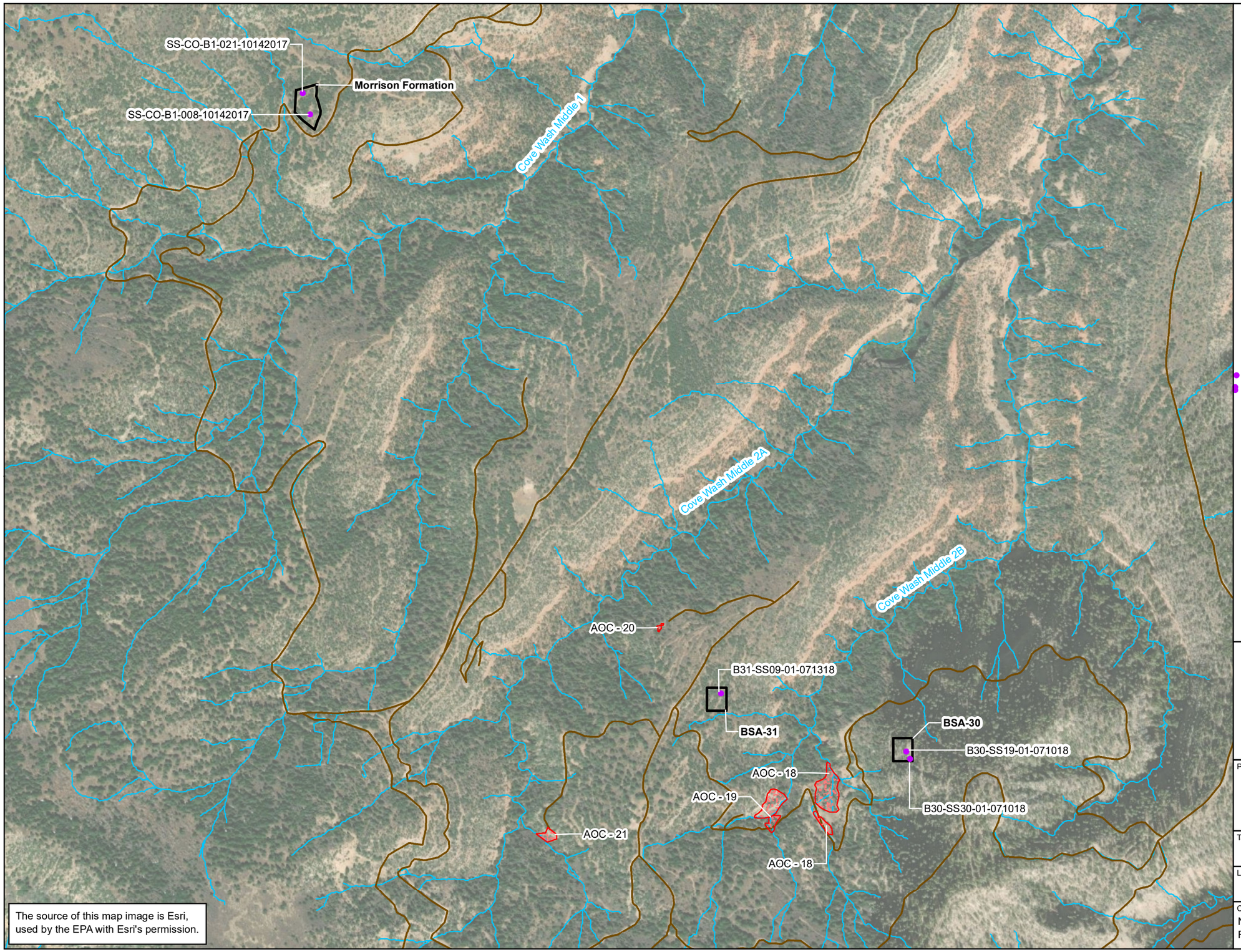
1:3,600

N W E S

300 150 0 300 Feet

MESA III
WASTE SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: COVE CHAPTER NAVAJO NATION	Date: 3/10/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 7



Background Surface Soil Sample Location
0-6 inches

Background Study Area (BSA)

Waste Pile

Historic Haul Route

Wash

Note:
AOC Area of concern

References: 43, pp. 3022, 3129; 63, p.64.

1 inch = 800 feet

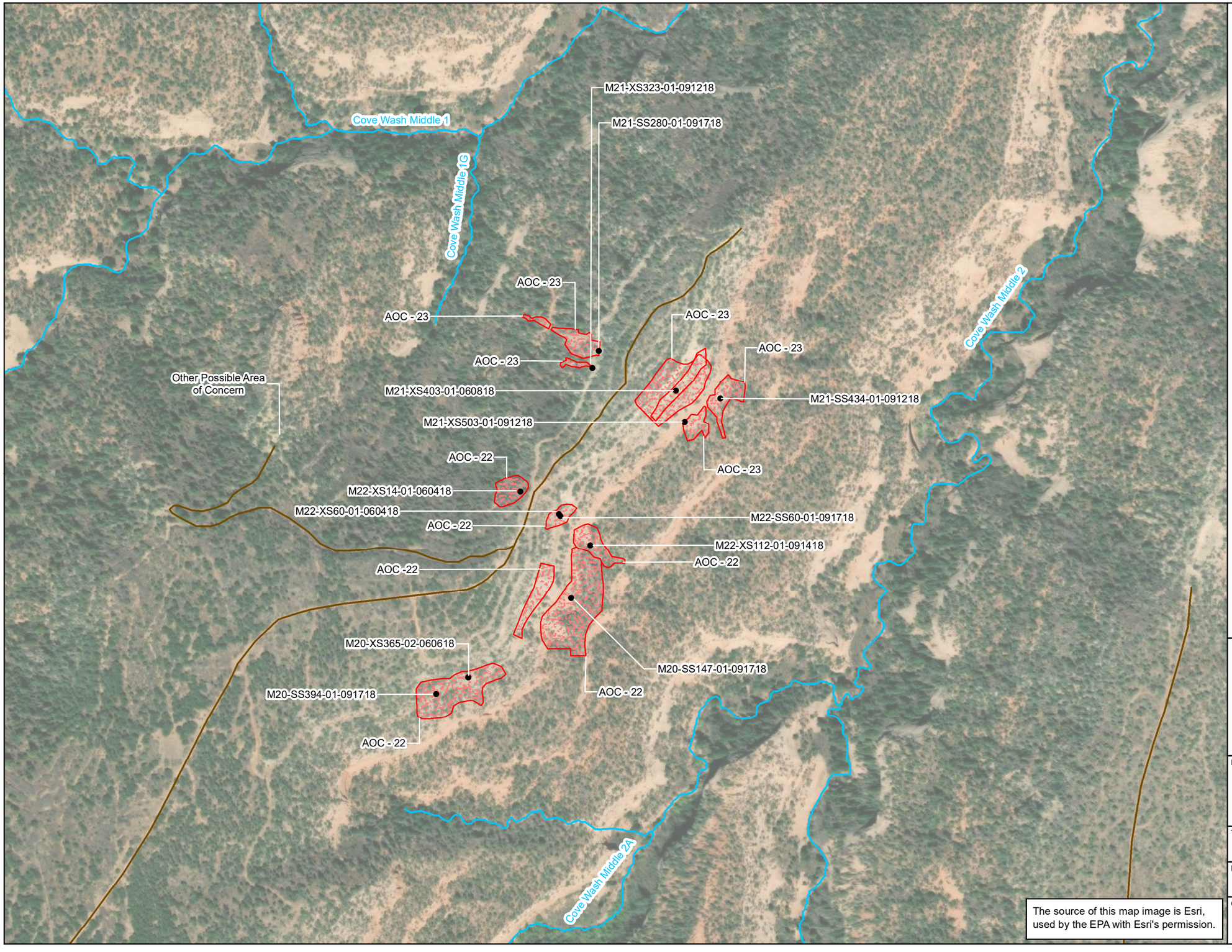
1:9,600

800 400 0 800 Feet

N W E S

MESA III
BACKGROUND SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: COVE CHAPTER NAVAJO NATION	Date: 3/7/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 8



Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

References: 20, pp.149, 150; 22, p.140; 21, pp.147, 148, 149.

1 inch = 400 feet

1:4,800

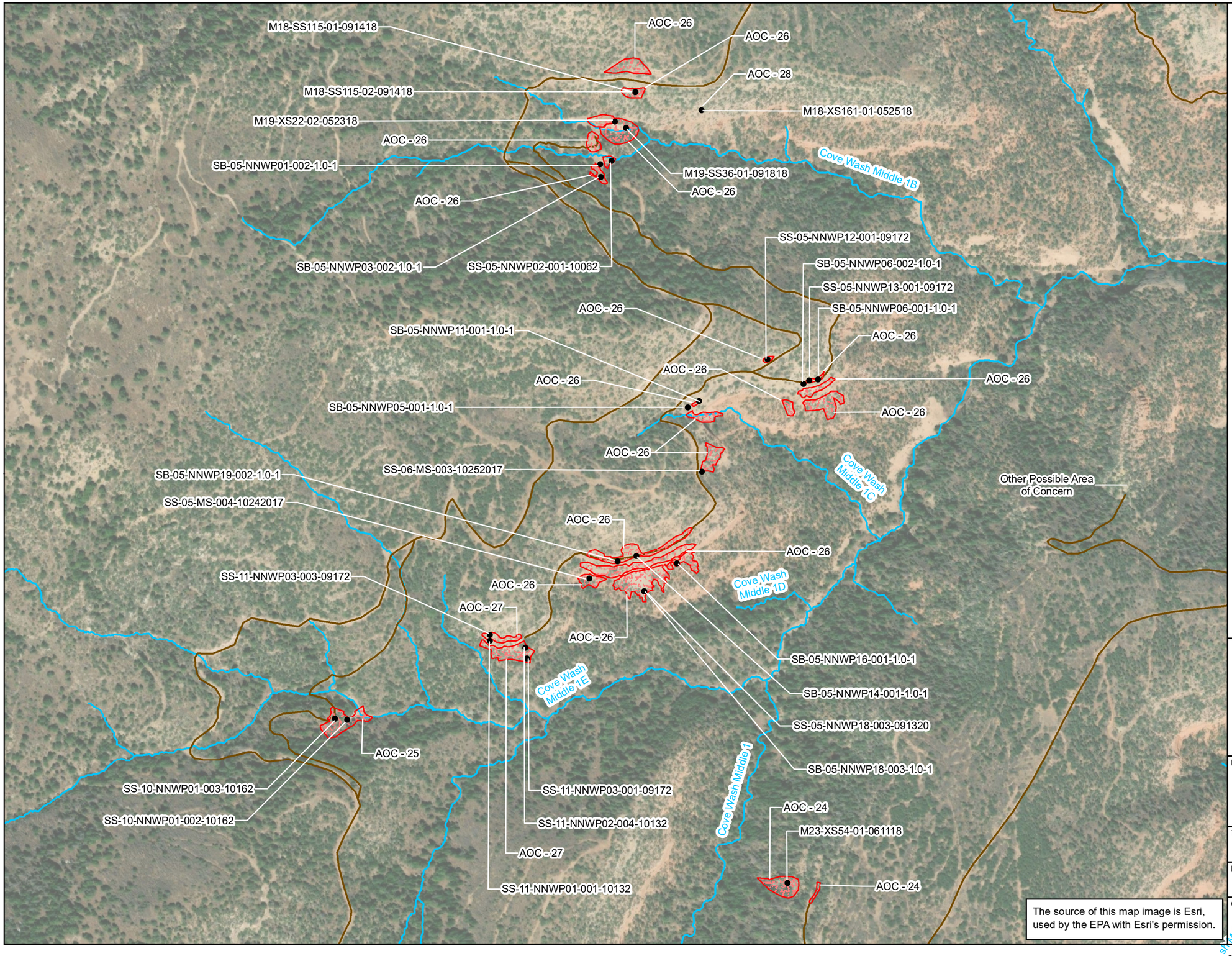
400 200 0 400 Feet

N W E S

The source of this map image is Esri, used by the EPA with Esri's permission.

MESA IV
WASTE SAMPLE LOCATIONS - EAST SIDE

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: COVE CHAPTER NAVAJO NATION	Date: 3/7/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 9



- Waste Sample Location[1]
- Waste Pile
- Historic Haul Route
- Wash

Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

References: 23, p.141; 79, p.22; 76, pp. 42, 43, 44, 45; 77, p.22; 19, p.145; 18, pp.143, 144; 78, p.22.

1 inch = 540 feet

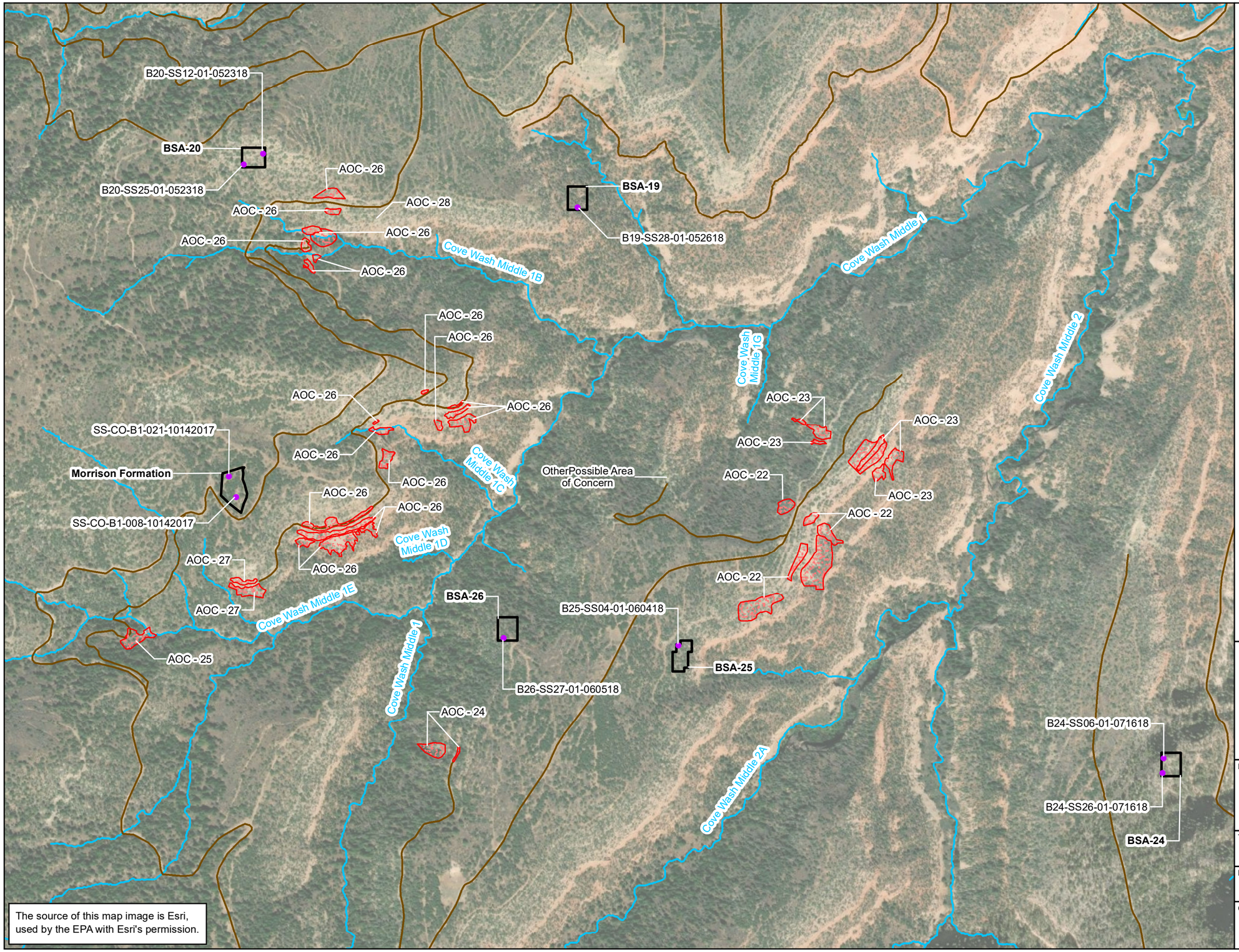
1:6,480

N W E S

540 270 0 540 Feet

MESA IV
WASTE SAMPLE LOCATIONS - WEST SIDE

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: COVE CHAPTER NAVAJO NATION	Date: 3/6/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 10



Background Surface Soil Sample Location
0-6 inches

Background Study Area (BSA)

Waste Pile

Historic Haul Route

Wash

Note:
AOC Area of concern

References: 43, pp.1988, 2091, 2502, 2606, 2709; 63, p.64.

1 inch = 800 feet

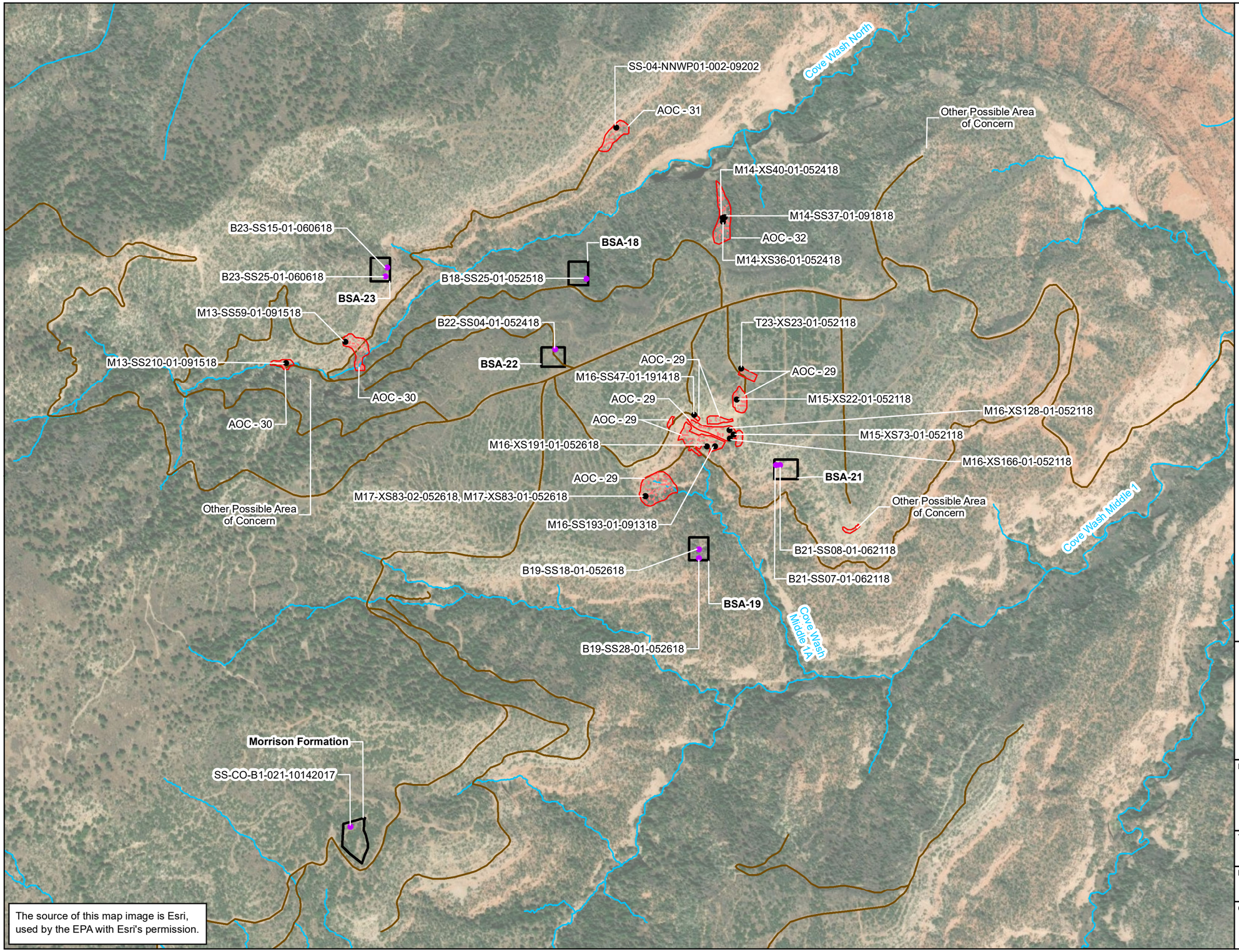
1:9,600

N W E S

800 400 0 800 Feet

MESA IV
BACKGROUND SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: COVE CHAPTER NAVAJO NATION	Date: 3/7/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 11



- Waste Sample Location[1]
- Background Surface Soil Sample Location *0-6 inches*
- Waste Pile
- Background Study Area (BSA)
- Historic Haul Route
- Wash

Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

References: 17, p.154; 16, pp.144, 145; 42, p.136; 15, p.140; 13, p.141; 75, p. 22; 14, p.140; 43, pp. 1885, 1988, 2194, 2296, 2399; 63, p.64.

1 inch = 800 feet

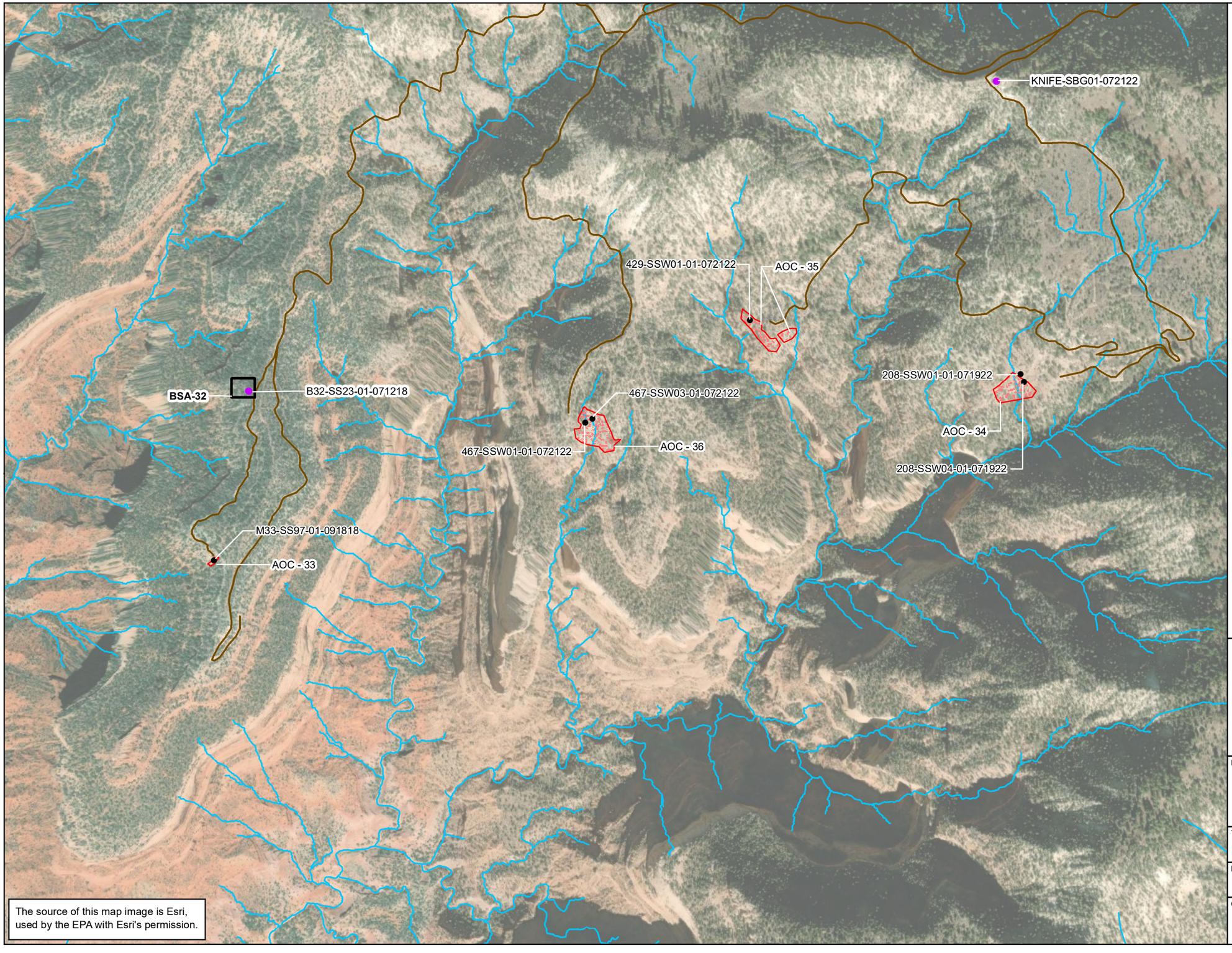
1:9,600

N W E S

800 400 0 800 Feet

MESA V AND VI BACKGROUND AND WASTE SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: COVE CHAPTER NAVAJO NATION	Date: 3/6/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 12



- Waste Sample Location[1]
- Background Surface Soil Sample Location *0-6 inches*
- Waste Pile
- Background Study Area (BSA)
- Historic Haul Route
- Wash

Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

References: 33, p.137; 186, pp.25, 26, 28, 29; 43, p.3234

1 inch = 800 feet

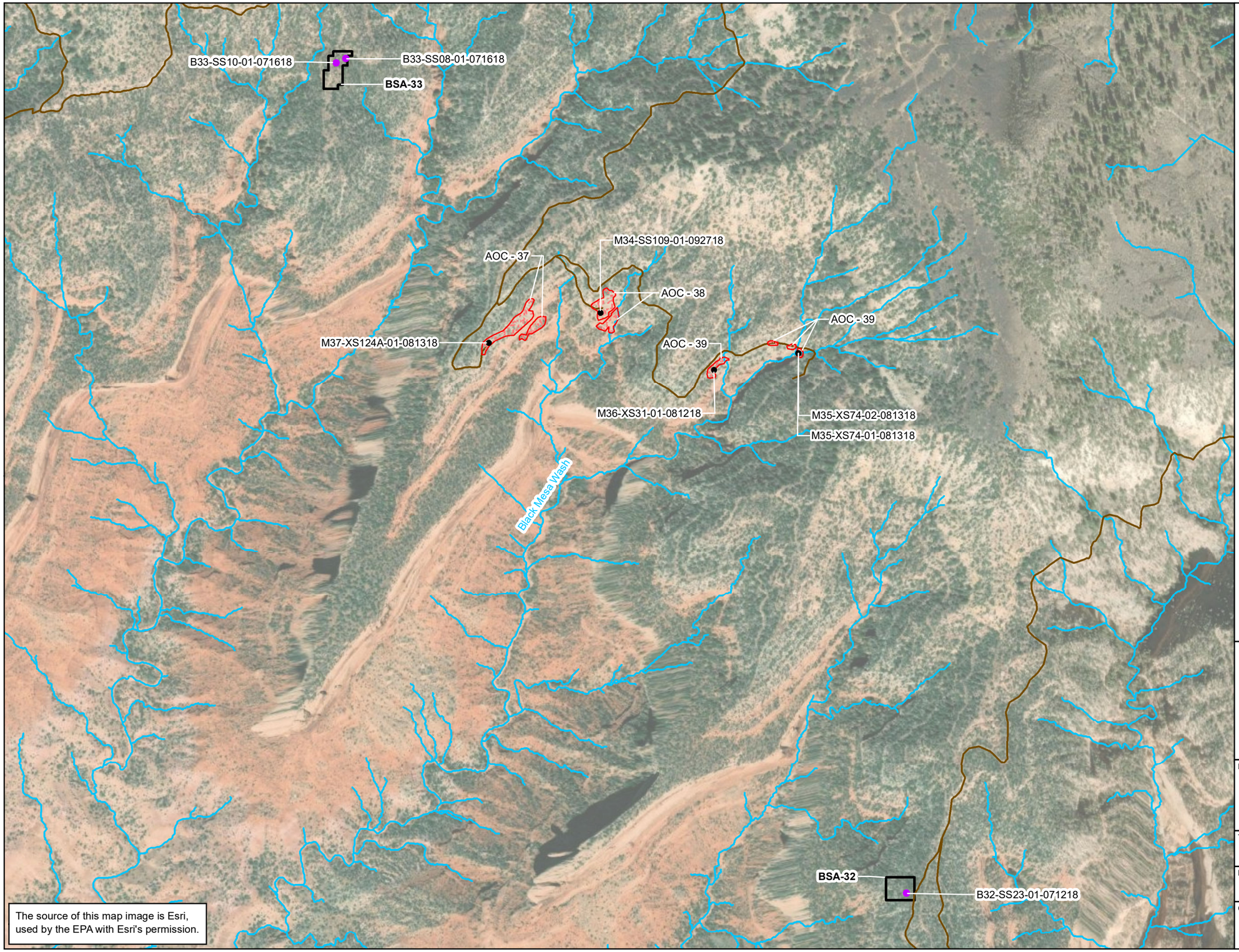
1:9,600

N W E S

800 400 0 800 Feet

KNIFE EDGE MESA BACKGROUND AND WASTE SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: LUKACHUKAI CHAPTER NAVAJO NATION	Date: 3/6/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 13



- Waste Sample Location[1]
- Background Surface Soil Sample Location *0-6 inches*
- Background Study Area (BSA)
- Waste Pile
- Historic Haul Route
- Wash

Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

References 34, p.140; 35, p.140; 36, p.140; 37, p.140; 43, pp. 3234, 3342.

1 inch = 660 feet

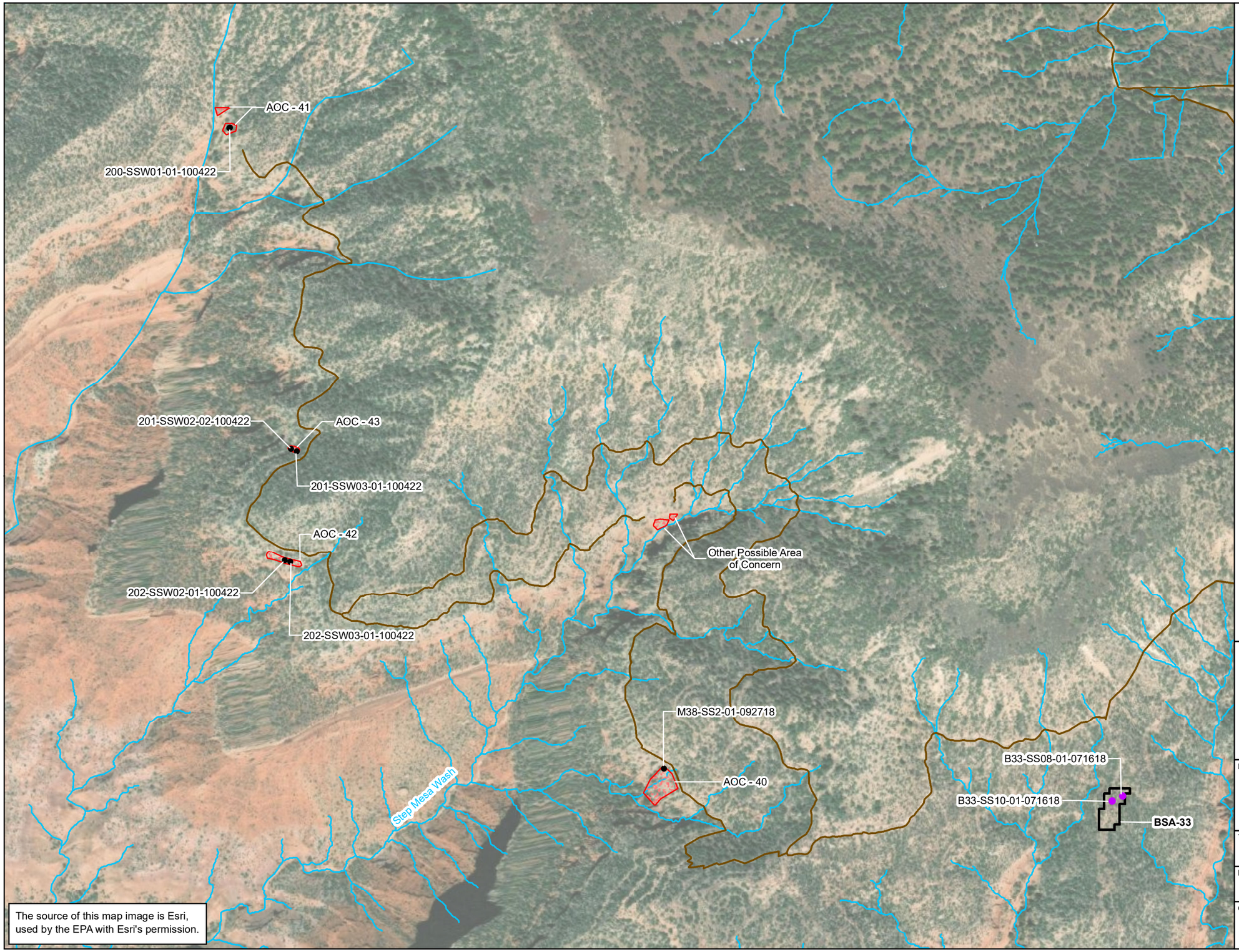
1:7,920

660 330 0 660 Feet

N W E S

FLAG MESA BACKGROUND AND WASTE SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: LUKACHUKAI CHAPTER NAVAJO NATION	Date: 3/6/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: **14**



- Waste Sample Location[1]
- Background Surface Soil Sample Location *0-6 inches*
- Waste Pile
- Background Study Area (BSA)
- Historic Haul Route
- Wash

Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

References: 38, p.42; 43, p.3342; 212, pp.13, 14, 15.

1 inch = 600 feet

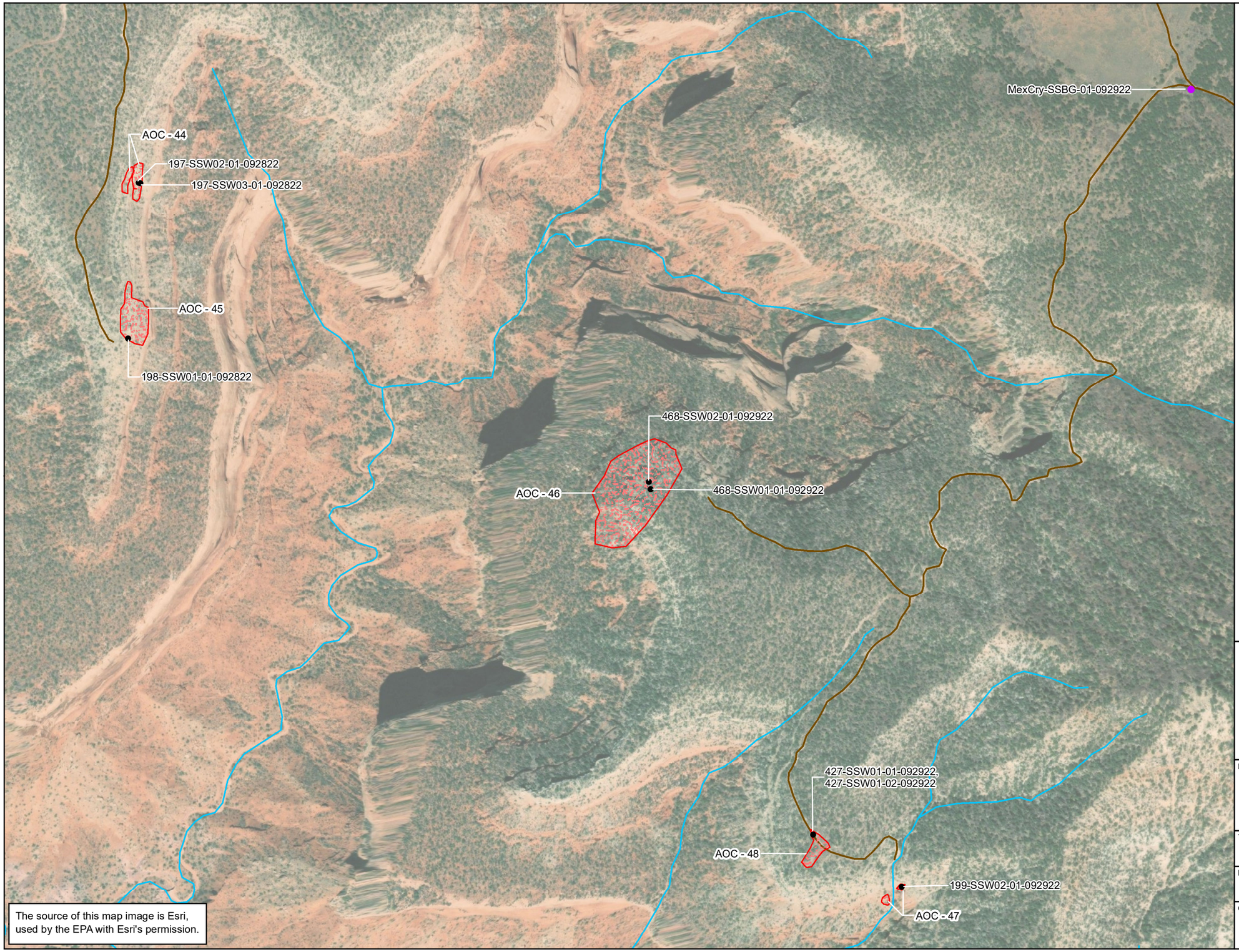
1:7,200

N W E S

600 300 0 600 Feet

STEP MESA BACKGROUND AND WASTE SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: LUKACHUKAI CHAPTER NAVAJO NATION	Date: 3/7/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 15



The source of this map image is Esri, used by the EPA with Esri's permission.

- Waste Sample Location[1]
- Background Surface Soil Sample Location *0-6 inches*
- Waste Pile
- Historic Haul Route
- Wash

Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

References: 213, pp.16, 17, 19, 20, 21.

1 inch = 540 feet

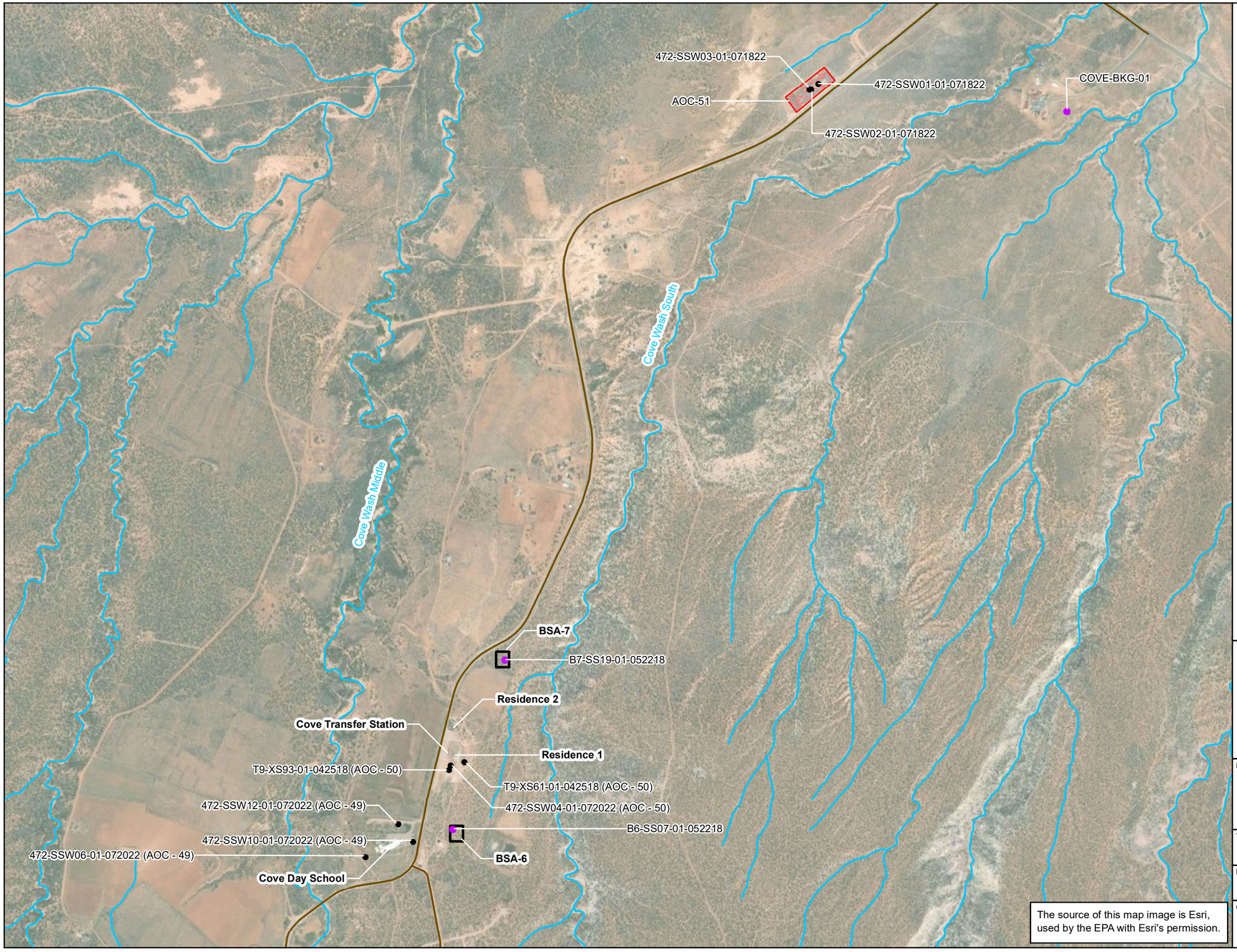
1:6,480

N W E S

540 270 0 540 Feet

MEXICAN CRY MESA BACKGROUND AND WASTE SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: NAVAJO NATION	Date: 3/6/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: **16**



- Waste Sample Location
- Background Surface Soil Sample Location *0-6 inches*
- Waste Pile
- Background Study Area (BSA)
- Historic Haul Route
- Wash

Notes:
AOC Area of concern

References: 40, p.167; 43, pp. 637, 741; 73, p. 2150, 2151, 2153, 2154, 2155.

1 inch = 1,200 feet

1:14,400

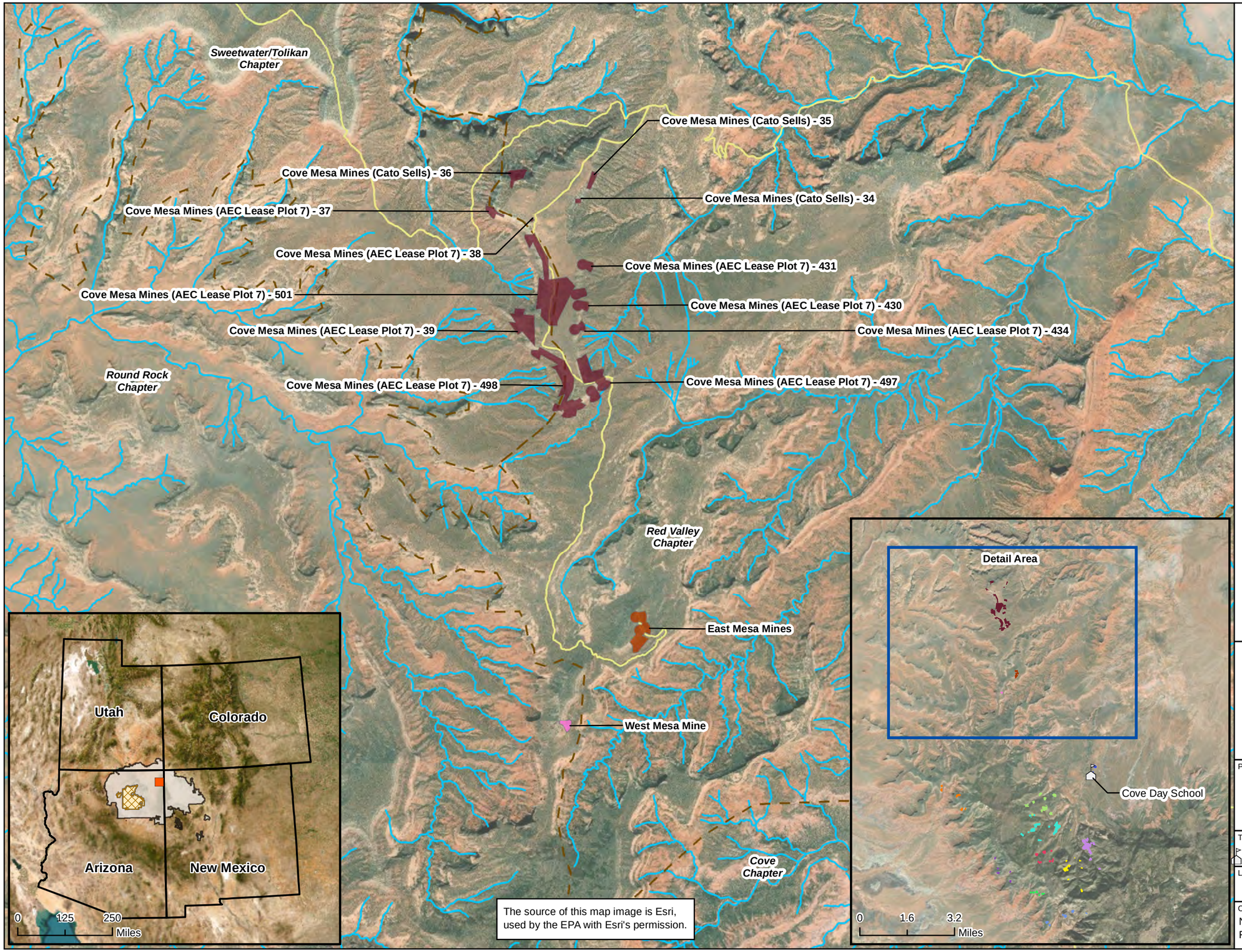
N W E S

1,200 600 0 1,200 Feet

The source of this map image is Esri, used by the EPA with Esri's permission.

COVE TRANSFER STATION BACKGROUND AND WASTE SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: LUKACHUKAI CHAPTER NAVAJO NATION	Date: 3/10/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 17



Lukachukai Mountains Mining District

Mines / Other Sources[1]

- Cove Mesa
- Cove Transfer Station
- East Mesa
- Flag Mesa
- Knife Edge Mesa
- Mesa I
- Mesa II
- Mesa III
- Mesa IV
- Mesa V and VI
- Mexican Cry Mesa
- Step Mesa
- West Mesa
- Navajo Nation Boundary
- Navajo Nation Chapter Boundary
- Hopi Reservation
- Historic Haul Route
- Wash
- Cove Day School

Note:
[1]Reference 71.

1 inch = 3,400 feet

1:40,800

N W E S

3,400 1,700 0 3,400 Feet

COVE MESA, EAST MESA, AND WEST MESA OTHER POSSIBLE AREAS OF CONCERN

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: NAVAJO NATION	Date: 1/12/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: **18**

- Waste Sample Location[1]
- Background Surface Soil Sample Location *0-6 inches*
- Waste Pile
- Historic Haul Route
- Wash

Notes:
[1]Waste pile boundaries are estimated; samples that appear to be outside the waste pile boundaries are representative of waste from the waste pile.
AOC Area of concern

References: 214, pp.30, 31, 32, 33, 35, 36, 37, 38, 39, 41, 42, 43.

1 inch = 2,400 feet

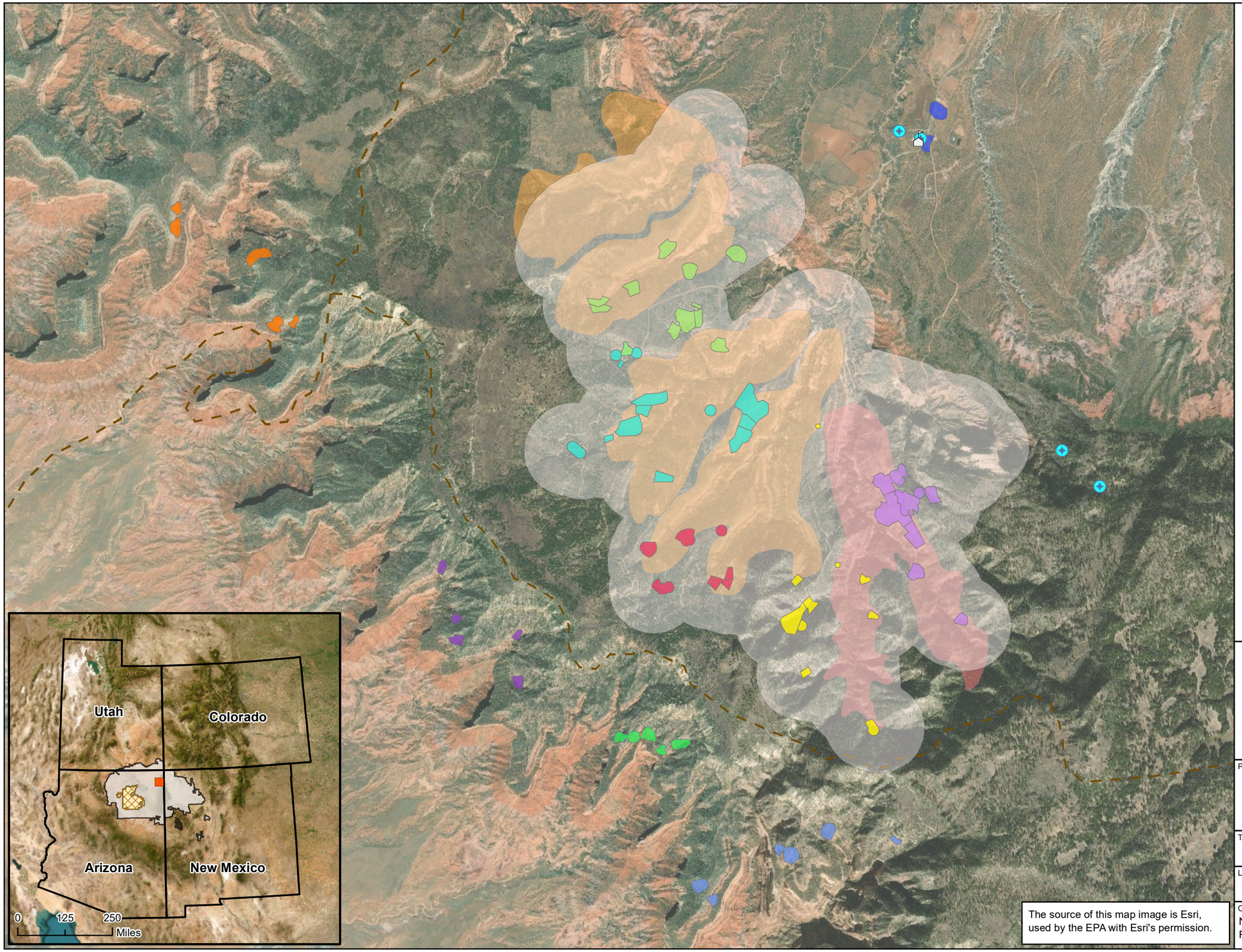
1:28,800

N W E S

2,400 1,200 0 2,400 Feet

COVE MESA BACKGROUND AND WASTE SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: NAVAJO NATION	Date: 3/6/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 19



Lukachukai Mountain Mining District
MSO Potential Nesting Habitat Buffer (0.25 miles)

Protected Activity Centers
- 2009
- 2018

Mines / Other Sources
- Cove Transfer Station
- Flag Mesa
- Knife Edge Mesa
- Mesa I
- Mesa II
- Mesa III
- Mesa IV
- Mesa V and VI
- Mexican Cry Mesa
- Step Mesa

Navajo Nation Boundary
Navajo Nation Chapter Boundary
Hopi Reservation
Historic Haul Route
Wash
Well (Domestic Use)
Cove Day School

Notes:
MSO Mexican spotted owl

References: 71, p.56; 72, p.20

1 inch = 3,400 feet

1:40,800

N
W E
S

3,400 1,700 0 3,400 Feet

The source of this map image is Esri, used by the EPA with Esri's permission.

LUKACHUKAI MOUNTAINS MINING DISTRICT - MEXICAN SPOTTED OWL PROTECTED ACTIVITY CENTERS AND BUFFERS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 0016	Contract No.: EP-S9-17-03
Location: NAVAJO NATION	Date: 3/6/2023
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 20

SITE DESCRIPTION

The Lukachukai Mountains were the location of a post-World War II and Cold War uranium and vanadium mining district operated by a series of mining companies under numerous mine claims and leases between 1949 and 1968 (see Figures 1 to 3) (Ref. 187, p. 34-53). The Lukachukai Mountains Mining District (LMMD) site is situated primarily in the Cove, Round Rock, and Lukachukai Chapters of the Navajo Nation in northeast Arizona. The HRS score for the LMMD site is based on 51 Areas of Observed Contamination (AOC) (see Figures 1, 4 to 17), comprising waste piles and contaminated soil throughout the LMMD site, scored under the soil exposure component of the soil exposure and subsurface intrusion pathway (see the table of AOCs at the end of this site description). The Navajo Nation supports the placement of the LMMD site on the NPL (Ref. 217).

"Lukachukai" is a Navajo word meaning "patches of white reeds" and refers to the many lakes occurring on the main flat-topped ridge of the mountains. The elevation of this ridge is about 8,800 feet above sea level, but isolated ridges rise as much as 100 feet higher. The Lukachukai Mountains trend northwestward, connect with the Carrizo Mountains to the northwest, and, except where they join with the Chuska Mountains to the southeast, terminate as precipitous cliffs on either side. Finger-like mesas and deep, steep-walled canyons combine to form very rugged topography. The finger-like mesas are not true mesas but were named and numbered as such by personnel of the U.S. Atomic Energy Commission (AEC) in late 1950. The prominent mesas on the north side of the mountains are numbered I through VII toward the northwest terminus at Mexican Cry Mesa. The southside mesas bear such descriptive names at Two Prong, Camp, Cisco, Three Point, Knife Edge, Bare Rock, Flag, Step, Fall Down, and Thirsty. In general, the mine claims are named for the mesas on which they occur and minor divisions such as Mesas I 1/2, I 3/4, II 1/2 and IV 1/2 do occur on the north side (Ref. 187, p.9).

Carnotite (uranium-vanadium ore) was discovered around 1918 in the Carrizo Mountains, north of the Lukachukai Mountains, and many mining claims were filed within the Carrizo and neighboring Lukachukai Mountains during the next few decades. The carnotite deposits are in the Salt Wash sandstone member of the Morrison Formation. The ore deposits consist of sandstone impregnated with carnotite and a vanadium-bearing mica. In general, the deposits tend to form clusters in ill-defined areas. The deposits are believed to have formed from groundwater solutions shortly after the accumulation of the enclosing sands (Ref. 188, pp.3,4).

Mine claims were given unique mine names based on the mesa where the claim was located to track ore extraction from specific claims throughout the LMMD site. These unique mine claim names became associated with individual LMMD surface features and are often referred to as abandoned uranium mines (AUM) by past and current USEPA and Navajo Nation Environmental Protection Agency (NNEPA) inventory and investigation efforts. Mining of uranium deposits in the Lukachukai Mountains commenced in 1950 and continued until 1968 (Ref. 187, pp.6,45). While some individual "one-off" claims with no corporate successor are scattered throughout the LMMD site, most claims were explored and mined by a sequence of three companies (Ref. 210, pp. 1-4):

- Kerr-McGee Oil Industries, Inc. (Kerr-McGee) (later Tronox)
- Vanadium Corporation of America (VCA) (later Cyprus Amax Minerals Company [Cyprus Amax], a wholly owned subsidiary of Freeport-McMoRan)
- Foote Mineral Company (later merged with Cyprus Amax)

A few other mines were concurrently explored and mined by the Climax Uranium Company. Foote Mineral Company and Climax Uranium Company were either acquired or merged into Cyprus Amax in 1988 and 1993, respectively (Refs. 193, p.6; 199, p.3; 209, p.2).

Kerr-McGee acquired mineral rights on properties in the Lukachukai Mountains in 1952 and was the leading producer of uranium until 1963, at which time VCA acquired its holdings (Ref. 187, p.6). The Climax Uranium

Company, a subsidiary of American Metals Climax, Inc., began prospecting in the Lukachukai Mountains about 1950 (Ref. 189, p.12). A total of 666,850 tons of uranium ore was mined in the Cove Chapter alone (Ref. 65, p.11).

The dominant mining methods in LMMD consisted of underground room and pillar, open stoping, incline shafts, and vertical shafts, resulting in waste piles comprising remnant overburden, protore, and other contaminated material. Some shallow or exposed ore bodies were successfully mined by rimstripping, trenching, and open pit methods (Ref. 191, p. 3). Because of the relatively shallow presence of the Morrison Formation and accessibility from cliff sides, many adits, portals, and surface-mining features were created to remove underground ore rather than a single portal as was used with deeper ore bodies (Refs. 187 p.46; 189 p.21; 208 p.33). Underground mining followed the uranium-vanadium-rich carnotite ore deposits, often resulting in underground connections of workings through multiple adits or portals.

The rugged topography made road building difficult and hazardous. Roads, ore transfer stations, and other infrastructure were owned, operated, or used collectively by LMMD mining companies and used by the other one-off mine claimants, interconnecting mining activities into one large mining operation throughout the mining district. Figure 2 shows the primary haul roads and drill trails that connect the various mine claims and ore extraction points throughout the LMMD site. Figure 2 also shows the sample locations where site-related contaminants were detected above background on the roads from spillage and road construction, maintenance, and use. Migration of waste from the waste piles has also resulted in comingled contamination in washes and drainages, surface water, and groundwater (Refs. 64, pp. 9,17; 65, p. 95). Figure 3 shows the primary drainages and surface water bodies emanating from the various AOCs and flowing through the Cove Valley below (Ref.207, pp.19-21). Figure 3 also shows sediment sample locations where site-related contaminants were detected above background as a result of mine waste migration (Refs. 73, p. 10; 206, p. 10; 62, p.151; 65, p. 95; 207, pp.19-21). More than 800,000 cubic yards of mine waste remains in waste piles and significant migration of waste has already occurred downgradient of mesas throughout surface water drainages in the LMMD (Ref. 62, p. 147).

In the 1980s through 2000s, the Navajo Abandoned Mine Lands (NAML) Program inventoried, assessed, and reclaimed the physical safety hazards associated with the AUM features in the LMMD site through funding and authority provided by the Surface Mine Closure and Reclamation Act (SMCRA). NAML inventory efforts assigned a series of numbers (commonly starting with “NA-” or Navajo Area). The numbering system is connected to problem areas identified by NAML during the SMCRA-approved inventory process—the LMMD site is in the Cove Abandoned Mine Land Problem Area, NA-0300s series. All accessible adits and portals within the LMMD were closed with the most feasible methods available at the time of the reclamation work. Waste piles accessible by heavy equipment underwent NAML reclamation and were renamed and renumbered as burial cells. The reclamation actions were not intended to fully address contamination, and all burial cells contain surficial contamination above background levels as evidenced by subsequent investigations. The burial cells are piles of waste moved from other locations and buried with 1.5 feet of borrow material, which meets the definition of a pile according to HRS definitions (Ref. 65, pp. 14, 71-76, 221-227). The cover material is less than 2 feet thick by design (Refs. 65, p. 226; 223, p. 20). No wastes were removed from the LMMD site as a result of reclamation actions (Refs. 65, pp. 14, 71-76, 221-227; 223, p.20).

In 2018, USEPA in coordination with NNEPA conducted an extensive removal site evaluation (RSE) under CERCLA. The RSE field effort included characterization of 39 AUMs, 37 AUM-related areas of suspected contamination, 22 miles of surface water drainages, nearly 10 miles of access roads, and 32 background study areas, each approximately ½ acre in area (Ref. 62, pp. 12, 16). Nine additional AUM areas in the LMMD site were investigated by Cyprus Amax in 2017 and reported in an RSE report in 2022 (Ref. 63, p. 15). This HRS documentation record is based primarily on the data resulting from these RSEs.

The Lukachukai and greater Chuska Mountains are heavily used by the Navajo people for hunting, plant gathering, and livestock grazing and provide habitat for several sensitive species, including the federally threatened Mexican spotted owl (*Strix occidentalis lucida*) (Refs. 66; 67; 72, p. 17). The Lukachukai Mountains are in an area that, while relatively small in size, is important to the maintenance of a unique biotic community used by the Navajo people for cultural, ceremonial, and medicinal purposes. Many ceremonial and medicinal plants and animals in the Lukachukai Mountains exist only in this area (Ref. 66). The Lukachukai Mountains also provide habitat for a dense aggregation of large vertebrates that provides unique hunting opportunities on the Navajo Nation (Ref. 67). Intermittent streams draining the Lukachukai Mountains, particularly the Cove Wash Watershed complex, are extensively contaminated by eroded waste from AUMs (Ref. 65, pp. 88-96). Wetlands along the Cove Wash headwater drainages support unique biotic communities in isolated pockets (Ref. 219). The community of Cove supports a residential population of approximately 400, and just under 50 children from the community attend the Cove Day School, which is located within an area of contaminated soil associated with a former ore transfer station (Refs. 65. p. 19; 70).

Table 1. Summary of AOCs

AOC No.	AOC Type	AOC Location	Waste Pile or Mine-Related Area Names
1	Pile	Mesa I	Waste Pile M3
2	Pile	Mesa I	Waste Pile M4; Burial Cell 9
3	Pile	Mesa I	Waste Piles M5A, M5B, and M5C
4	Pile	Mesa I	Waste Pile M6
5	Pile	Mesa I	Waste Piles M7A, M7B, and M7C
6	Pile	Mesa I	Waste Piles M8A and M8B; Burial Cells 6a, 6b, and 7
7	Pile	Mesa I	Waste Piles T17A and T17B; Burial Cell 310AB
8	Pile	Mesa I	Waste Pile M9
9	Pile	Mesa I	Waste Piles M10A and M10B
10	Pile	Mesa II	Waste Pile M12
11	Pile	Mesa II	Waste Pile M25; Burial Cells 31a and 31b
12	Pile	Mesa II	Waste Piles M27 and M28; Burial Cell 39
13	Pile	Mesa II	Waste Piles M29A and M29B; Burial Cell 43
14	Pile	Mesa II	Waste Pile M24; Burial Cell 44
15	Pile	Mesa II	CO-07_NNWP01 and CO-07_NNWP02
16	Pile	Mesa II	Waste Pile M11
17	Pile	Mesa II	CO-03_CAWP01
18	Pile	Mesa III	Waste Pile M30; Burial Cell 48
19	Pile	Mesa III	Waste Piles M31 and M32
20	Pile	Mesa III	CO-08 CAWP01
21	Pile	Mesa III	CO-09_NNWP01
22	Pile	Mesa IV	Waste Piles M20A, M20B, M22A, M22B, M22C; Burial Cell 56
23	Pile	Mesa IV	Waste Piles M21A, M21B, M21C, M21D, M21E, and M21F; Burial Cell 63
24	Pile	Mesa IV	Waste Pile M23; Burial Cell 70b
25	Pile	Mesa IV	CO-10_NNWP01
26	Pile	Mesa IV	CO-05_NNWP14, CO-05_NNWP15. CO-05_NNWP16, CO-05_NNWP17, CO-05_NNWP18, and CO-05_NNWP19, CO-05_NNWP05, CO-05_NNWP06, CO-05_NNWP07, CO-05_NNWP08, CO-05_NNWP09, CO-05_NNWP10, CO-05_NNWP11, CO-05_NNWP12, and CO-05-NNWP13, CO-

Table 1. Summary of AOCs			
AOC No.	**AOC Type**	**AOC Location**	**Waste Pile or Mine-Related Area Names**
			05_NNWP01, CO-05_NNWP02, CO-05_NNWP03, and CO-05_NNWP04, CO-06_NNWP01; Waste Piles M18 and M19; Burial Cells 86b and 87a
27	Pile	Mesa IV	CO-11_NNWP01, CO-11_NNWP02, and CO-11_NNWP03
28	Pile	Mesa IV	Cov087 Waste Pile
29	Pile	Mesa V & Mesa VI	Waste Piles M15A, M15B, M16A, M16B, and M17; Burial Cells 91, 92, 93, and 344B-2
30	Pile	Mesa V & Mesa VI	Waste Piles M13A and M13B
31	Pile	Mesa V & Mesa VI	CO-04_NNWP01
32	Pile	Mesa V & Mesa VI	Waste Pile M14
33	Pile	Knife Edge Mesa	Waste Pile M33
34	Pile	Knife Edge Mesa	Waste Pile M52
35	Pile	Knife Edge Mesa	Waste Pile M53A and M53B
36	Pile	Knife Edge Mesa	Waste Pile M54
37	Pile	Flag Mesa	Waste Piles M37A and M37B
38	Pile	Flag Mesa	Waste Piles M34A and M34B
39	Pile	Flag Mesa	Waste Piles M35A, M35B, M35C, and M36
40	Pile	Step Mesa	Waste Pile M38
41	Pile	Step Mesa	Jimmie King No. 9 Waste Pile
42	Pile	Step Mesa	NA-0332 Waste Pile
43	Pile	Step Mesa	NA-0333 Waste Pile
44	Pile	Mexican Cry Mesa	Mexican Cry 197 Waste Pile
45	Pile	Mexican Cry Mesa	Mexican Cry 198 Waste Pile
46	Pile	Mexican Cry Mesa	Hall Mine Waste Pile
47	Pile	Mexican Cry Mesa	Nakai Chee Begay Waste Pile
48	Pile	Mexican Cry Mesa	Tom Joe No. 6 Waste Pile
49	Contam. Soil	Cove Transfer Station	Cove Day School yard contaminated soil
50	Contam. Soil	Cove Transfer Station	Residence 1 contaminated soil
51	Pile	Cove Transfer Station	CTS2 Stockpile

Several Other Possible AOCs on Cove Mesa, East Mesa, and West Mesa are described later in this HRS documentation record. Each of these Other Possible AOCs has been sampled and found to be contaminated with the same contaminants as the scored AOCs (see Figures 18 and 19). These other possible AOCs are:

Table 2. Other Possible AOCs on Cove Mesa, East Mesa, and West Mesa		
Number	**Location**	**Mine Claim Names**
Other Possible AOC 1	Cove Mesa	Cove Mesa Mines (Cato Sells 34)
Other Possible AOC 2	Cove Mesa	Cove Mesa Mines (Cato Sells 35)
Other Possible AOC 3	Cove Mesa	Cove Mesa Mines (Cato Sells 36)
Other Possible AOC 4	Cove Mesa	Cove Mesa Mines (AEC Lease Plot 7) - 37
Other Possible AOC 5	Cove Mesa	Cove Mesa Mines (AEC Lease Plot 7) - 38

Table 2. Other Possible AOCs on Cove Mesa, East Mesa, and West Mesa		
Number	**Location**	**Mine Claim Names**
Other Possible AOC 6	Cove Mesa	Cove Mesa Mines (AEC Lease Plot 7) - 39
Other Possible AOC 7	Cove Mesa	Cove Mesa Mines (AEC Lease Plot 7) - 430
Other Possible AOC 8	Cove Mesa	Cove Mesa Mines (AEC Lease Plot 7) - 431
Other Possible AOC 9	Cove Mesa	Cove Mesa Mines (AEC Lease Plot 7) - 434
Other Possible AOC 10	Cove Mesa	Cove Mesa Mines (AEC Lease Plot 7) - 497
Other Possible AOC 11	Cove Mesa	Cove Mesa Mines (AEC Lease Plot 7) - 498
Other Possible AOC 12	Cove Mesa	Cove Mesa Mines (AEC Lease Plot 7) - 501
Other Possible AOC 13	East Mesa	East Mesa Mines
Other Possible AOC 14	West Mesa	West Mesa Mine

5.0 SOIL EXPOSURE AND SUBSURFACE INTRUSION PATHWAY

5.0.1 EXPOSURE COMPONENTS

Component being scored: soil exposure component.

5.1 SOIL EXPOSURE COMPONENT

The soil exposure component is scored based on 51 areas of observed contamination (AOCs) resulting from a mining operation in the LMMD site that extracted ore from the Salt Wash Member of the Lower Morrison Formation. The AOCs are all mine waste piles (49 AOCs) and associated contaminated soil (2 AOCs) with similar waste characteristics. All AOCs are interconnected by mining-impacted haul roads, common usage of ore transfer stations, and contamination that has migrated from the AOCs to intermittent or ephemeral streams (also called drainages) (see Figures 2 and 3). Further investigation is necessary at eight additional areas of concern located between and near scored AOCs, including additional waste piles and contaminated soil.

To facilitate the review of this HRS documentation record, descriptions and data used in HRS scoring are grouped geographically by the following LMMD mesas and the Cove Transfer Station (see Figure 1):

1. Mesa I (nine AOCs)
2. Mesa II (eight AOCs)
3. Mesa III (four AOCs and two other areas of concern)
4. Mesa IV (seven AOCs and one other area of concern)
5. Mesa V and Mesa VI (four AOCs and four other areas of concern)
6. Knife Edge Mesa (four AOCs and one other area of concern)
7. Flag Mesa (three AOCs)
8. Step Mesa (four AOCs and one other area of concern)
9. Mexican Cry Mesa (five AOCs)
10. Cove Transfer Station (three AOCs)

In addition to the AOCs and associated areas of concern, 14 “Other Possible AOCs” exist on nearby Cove Mesa, East Mesa, and West Mesa. These Other Possible AOCs meet the observed contamination criteria and are described in more detail at the end of Section 5.1.0.

5.1.0 GENERAL CONSIDERATIONS

The analytical data used to score the following AOCs was collected under USEPA approved sampling Work Plans, which included Sampling and Analysis Plans, Quality Assurance Project Plans, and Field Sampling Plans (Refs. 93; 221; 222). USEPA and Navajo EPA reviewed these Work Plans to ensure consistency in sampling and analysis methodology (Refs. 93; 221; 222). The separate RSE data collection efforts were performed using comparable methodologies.

In 2018, USEPA in coordination with NNEPA conducted an RSE under CERCLA (Ref. 221, p. 11). The RSE included characterization of 39 AUMs, 37 AUM-related areas of suspected contamination, 22 miles of surface water drainages, nearly 10 miles of access roads, and 32 background study areas, each approximately ½ acre in area (Refs. 62, pp. 12,16; 221, pp. 11,14). Nine additional AUM areas in the LMMD site were investigated by Cyprus Amax in 2017 and reported in an RSE report dated October 2022 (Refs. 63, p. 15; 222, pp. 7,8,9). USEPA and Navajo EPA reviewed the Cyprus Amax sampling Work Plan to ensure that the sampling and analysis procedures were consistent with those used by USEPA (Ref. 199, p. 117). In 2022, USEPA conducted additional sampling of previously unsampled AOCs in 2022 following the 2018 Work Plan (Refs. 93; 221).

All but two of the AOCs evaluated in this section are waste piles. To clarify terminology used in other reports, the term "Burial Cells" refers to a waste pile created by reclamation activities performed by the Navajo Abandoned Mine Lands Program (Ref. 65, p. 11). The term burial cell was used by investigators to differentiate un-reclaimed waste piles from those reclaimed by NAML (Ref. 65, pp. 11,62,98). NAML's priority was to reclaim physical safety hazards, not to clean up the contamination at the mines (Ref. 65, p. 11). NAML often moved mine waste from un-reclaimed waste piles to cover physical hazards such as portals or highwalls, creating new waste piles also known as burial cells (Ref. 223, pp. 20-22). Burial cells were typically covered with "Class A" material to a depth of 18 inches (Refs 65, p. 62; 223, p. 22). Class A material was intended to be material from mine waste piles, overburden, subsoil, topsoil or other suitable backfill material with Ra-226 concentration equal to or less than the average Ra-226 concentration of the background area in the immediate vicinity (Ref. 223, p. 18).

Recent investigations of burial cells have found contamination significantly above background in surface waste within the top 6 inches, indicating that any remaining Class A cover either contained hazardous substances above background at the time of reclamation or has subsequently been eroded or removed from the surface of the burial cells. All reclamation work performed by NAML was completed by 2004 (Ref. 65, p. 74).

Areas of Observed Contamination 1 through 9 – Mesa I

Nine AOCs are scored as a result of mining activities at Mesa I. The AOCs comprise waste piles created from a mining operation that extracted uranium ore from eight named mine claims: Mesa I Mine 10, Mesa I Mine 11, Mesa I Mine 12, Mesa I Mine 13, Mesa I Mine 14, Mesa I Mine 15, Mesa I 1/4 Mine, and Mesa I 1/2 Mine (Refs. 4, p.26; 5, p.27; 6, p.26; 7, p.27; 8, p.27). An additional AOC waste pile is located at the Mesa I Camp, which was used early on as a staging area for field operations for exploration at the LMMD site (Refs. 4, p.26; 41, p.26). Mesa I Camp was established by F.A. Sitton in 1950 and used until 1954 when operations were moved to an area near the Cove Day School now known as the Cove Transfer Station (Ref. 41, p.26). Mesa I Camp is the location of a waste pile comprising consolidated waste moved by the Navajo Abandoned Mine Lands program in the 2000s.

Table 3. Mesa I AOCs

AOC No.	AOC Type	Mine/Claim Name	RSE Waste Pile Names
1	Pile	Mesa I Mine 10	Waste Pile M3
2	Pile	Mesa I Mine 11	Waste Pile M4; Burial Cell 9
3	Pile	Mesa I Mine 12	Waste Piles M5A, M5B, and M5C
4	Pile	Mesa I Mine 13	Waste Pile M6
5	Pile	Mesa I Mine 14	Waste Piles M7A, M7B, and M7C
6	Pile	Mesa I Mine 15	Waste Piles M8A and M8B; Burial Cells 6a, 6b, and 7
7	Pile	Mesa I Camp	Waste Piles T17A and T17B; Burial Cell 310AB
8	Pile	Mesa I 1/4 Mine	Waste Pile M9
9	Pile	Mesa I 1/2 Mine	Waste Piles M10A and M10B

The mine claims were developed and operated in the 1950s and 1960s by F.A. Sitton, the Navajo Uranium Mining Company, Kerr-McGee (a predecessor of Tronox), and VCA (Refs. 4, p.26; 5, p.27; 6, p.26; 7, p.27; 8, p.27). Operations included underground mining that tapped paleochannels in the Salt Wash Member of the Lower Morrison Formation that are rich in uranium and vanadium (Refs. 4, p.24; 5, p.24; 6, p.23; 7, p.24; 8, p.24; 9, p.22; 10, p.22; 41, p.23). Underground mine workings exist throughout Mesa I. The scored AOCs consist of waste piles of overburden or lower grade protore discarded near or downslope of portals, and waste that has been pushed or has migrated downslope into drainages (Refs. 3, pp.23,29; 4, pp.22,28; 5, pp.23,29; 6, pp.22,28; 7, pp.23,29; 8, pp.23,29; 9, pp.21,26; 10, pp.21,26; 41, pp.22,28).

Number by which this AOC is to be identified: 1

Name of AOC: Mesa I Mine 10 Waste Pile M3

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 4

AOC 1 comprises one waste pile: Mesa I Mine 10 Waste Pile M3. The waste in AOC 1 is the byproduct of mine operations in ore deposits within the Salt Wash Member of the Lower Morrison Formation (Ref. 3, p.24). This waste pile is 5 to 10 feet deep with a slope ranging from 11 to 54 degrees. AOC 1 is highly erodible, and offsite migration has been documented and most likely flows down to the Cove Wash Middle 3F drainage located north of the mine (Ref. 3, p.32). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater. Mesa I Mine 10 is adjacent to Mesa I Mine 13 (Ref. 3, p.25).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 3, p.35; 43, p.1382, 1384; 200 p.1). For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest site-specific background concentration.

BSA-13 was selected as the most appropriate background location for AOC 1 because it is within the same geologic unit (lower Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 43, pp.45,46,1362,1365). The highest background concentration for each metals analyte from the 30 samples comprising BSA-13 was used as the background level for AOC 1 (Ref. 43, pp. 45,46,1385). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A inductively coupled plasma mass spectrometry (ICP-MS) (Refs. 87, pp.2,58; 88, p. 6; 87, p. 6; 150, p.2,27).

Table 4. Sample Description and Analytical Results for AOC 1

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 13)								3, p.35; 43, pp.1382, 1384
B13-SS20-01-071518	0-6”	Silty sand	1807350-23	7/15/18	Arsenic (mg/kg)	2.0	0.23	43, pp.6884, 6885,6689; 88, pp.6,65; 220, p.361, 362
B13-SS23-01-071518	0-6”	Silty sand	1807350-26	7/15/18	Uranium (mg/kg)	0.85	0.011	43, pp.6884, 6885,6689; 88, pp.6,71; 220, pp.361, 362

Table 4. Sample Description and Analytical Results for AOC 1								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
AOC Sample – Mesa I Mine 10 Waste Pile M3								
M3-XS36-01-043018	0-3”	Sandy silt loam	1805042-2	4/30/18	Arsenic (mg/kg)	8.2	0.19	150, p.27; 87, p.6; 220, pp.10, 11
M3-SS36-01-091618	0-6”	Sandy silt loam	1809428-10	9/16/18	Uranium (mg/kg)	86	0.01	3, p.186; 87, pp.6,58; 220, p.863

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions (Refs. 1, Section 1.1.; 25, p. 2-47).

Number by which this AOC is to be identified: 2

Name of AOC (Source Type): Mesa I Mine 11 Waste Pile M4 and Burial Cell 9 (Pile)

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 4

AOC 2 comprises two aggregated waste piles of the same waste material: Mesa I Mine 11 Mine Waste Pile M4 and Burial Cell 9. The waste in AOC 2 is the byproduct of mine operations in ore deposits within the Salt Wash Member of the Lower Morrison Formation (Ref. 4, p.23). Waste Pile M4 and Burial Cell 9 are close to one another in the central and northwestern portions of the Mesa I Mine 11 Mine (Ref. 4, pp.32,33). Waste Pile M4 is 3 to 4 feet deep and located on a slope greater than 30 degrees in places (Ref. 4, p.32). Burial Cell 9 is well vegetated (Ref. 4, p.32). The primary waterway drainage at the mine runs through Waste Pile M4. The waste pile is highly erodible and likely acts as a source for the transport of waste material downslope into the canyon below where the Cove Wash Middle 3 drainage lies (Ref. 4, pp.22,24). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The workings for Mesa I Mine 11 extend into the adjacent Mesa I Mine 15 area (Ref. 4, pp.24,25,27,28).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs: 4, p.35; 43, p.960). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-9 was selected as the most appropriate background location for AOC 2 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 43, pp. 45,46,940,943). The highest background concentration for each metals analyte from the 30 samples

comprising BSA-9 was used as the background level for AOC 2 (Ref. 43, p. 963). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-9 was used as the background level for AOC 2 (Refs. 43, pp. 966; 200, p.2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 89, pp.2,34,36; 151, pp.2,66). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 151, pp.2,105).

Table 5. Sample Description and Analytical Results for AOC 2

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 9)								4, p.35; 43, p.961,962
B9-SS04-01-050718	0-6”	Sandy loam	1805320-8	5/7/18	Lead (mg/kg)	6.3	0.21	43, p.6850; 90, pp.6,36; 220, pp.36,37
B9-SS04-01-050718	0-6”	Sandy loam	1805320-8	5/7/18	Uranium (mg/kg)	2.0	0.011	43, p.6850; 90, pp.6,36; 220, pp.36,37
BSA-9	0-6”	Sandy loam	1805319	5/7/18	Radium-226 (pCi/g)	1.94*	NA	43, p.6850; 90, p.10; 200, p.2; 220, p.30
AOC Samples – Mesa I Mine 11 Waste Pile M4 and Burial Cell 9								
M4-XS63-02-050718	0-3”	Waste rock sand	1805322-8	5/7/18	Lead (mg/kg)	20	0.2	89, pp.6,36; 220, p.49
M4-SS81-01-091818	0-6”	Silty sand	1809412-16	9/18/18	Uranium (mg/kg)	130	0.088	4, p.222; 151, pp.5,66; 220, p.556, 557
M4-SS176-01-091818	0-6”	Silty sand	1809413-11	9/18/18	Radium-226 (pCi/g)	102 M3	NA	4, p.225; 151, p.13,105; 220, p.562

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, p.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC (Ref. 151, p.105).

Number by which this AOC is to be identified: 3

Name of AOC: Mesa I Mine 12 Waste Pile M5A, Waste Pile M5B, and Waste Pile M5C
AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 4

AOC 3 comprises three waste piles: Mesa I Mine 12 Waste Pile M5A, Waste Pile M5B, and Waste Pile M5C. All three waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history (Ref. 5, pp.33,35). Waste Pile M5B is the largest of the three waste piles with an approximate depth of 7.5 feet. This waste pile is highly erodible and likely erodes downgradient to the Cove Wash Middle 3E drainage (Ref. 5, p.33). Waste Pile M5A is smaller and contains more vegetation. Waste Pile M5A is approximately 2 feet deep (Ref. 5, p.33). Waste Piles M5A and M5B sit on a slope greater than 30 degrees. Waste Pile M5C is an extension of Waste Piles M5A and M5B. Waste Pile M5C is below a cliff in the southwestern portion of the mine and accessible from the Cove Wash Middle 3E drainage. Offsite migration at Waste Pile M5C was documented as the Cove Wash Middle 3E drainage cuts directly through the mine feature. Drainages and erosional features are present on all three waste piles (Ref. 5, p.33). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 5, pp.24,25). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The workings for Mesa I Mine 12 are connected to Mesa I Mine 13 (Ref. 5, pp.28,29).

All waste samples are surface samples collected from the waste piles but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs: 5, p.37; 43, p.960). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-9 was selected as the most appropriate background location for AOC 3 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC in the same geology and soil type (Ref. 43, pp. 45,46,940,943). The highest background concentration for each metals analyte from the 30 samples comprising BSA-9 was used as the background level for AOC 3 (Ref. 43, p. 963). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-9 was used as the background level for AOC 3 (Refs. 43, pp. 966; 200, p.2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 91, pp.2,115,117). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 91, pp.2,228,230).

Table 6. Sample Description and Analytical Results for AOC 3

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 9)								5, p.37; 43, p.960
B9-SS04-01-	0-6”	Sandy loam	1805320-8	5/7/18	Uranium (mg/kg)	2.0	0.011	43, pp.6850, 6851; 90,

Table 6. Sample Description and Analytical Results for AOC 3								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
050718								pp.6,36; 220, p.36, 37
BSA-9	0-6”	Sandy loam	1805319	5/7/18	Radium-226 (pCi/g)	1.94*	NA	43, pp.6850, 6851; 200, p.1; 90, p.10; 220, p.30
AOC Sample – Mesa I Mine 12 Waste Pile M5A								
M5-SS149-01-093018	0-6”	Silty sand	1810124-33	9/30/18	Uranium (mg/kg)	79	0.084	5, p.241; 91, pp.7, 115; 220, pp.824, 825
M5-SS149-01-093018	0-6”	Silty sand	1810125-33	9/30/18	Radium-226 (pCi/g)	36	NA	5, p.241; 91, pp. 11, 228; 220, pp.834, 835
AOC Sample – Mesa I Mine 12 Waste Pile M5B and Waste Pile M5C								
M5-SS185-01-093018	0-6”	Silty sand	1810124-34	9/30/18	Uranium (mg/kg)	270	0.098	5, p.242; 91, pp.7, 117; 220, p.824, 825
M5-SS185-01-093018	0-6”	Silty sand	1810125-34	9/30/18	Radium-226 (pCi/g)	152	NA	5, p.242; 91, pp. 11, 230; 220, pp.834, 835

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 4

Name of AOC: Mesa I Mine 13 Waste Pile M6

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 4

AOC 4 comprises one waste pile: Mesa I Mine 13 Waste Pile M6. AOC 4 has high potential for erosion and offsite migration because of its location directly within the Cove Wash Middle 3F drainage, which bisects the Mesa I Mine 13 area (Ref. 6, pp.32,33). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 6, pp.23,24). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater. The workings for Mesa I Mine 13 and Mesa I Mine 12 are interconnected beneath the mesa (Ref. 6, p. 27, 28).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs: 6, p.35; 43, p.960). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-9 was selected as the most appropriate background location for AOC 4 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC in the same geology and soil type (Ref. 43, pp. 45,46,940,943). The highest background concentration for each metals analyte from the 30 samples comprising BSA-9 was used as the background level for AOC 4 (Ref. 43, p. 963). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-9 was used as the background level for AOC 4 (Refs. 43, pp.966; 200, p.2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 120, pp.2,88; 154, pp.2,51). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 154, pp.2,166).

Table 7. Sample Description and Analytical Results for AOC 4

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 9)								6, p.35; 43, pp.960,962
B9-SS12-01-050718	0-6”	Sandy loam	1805320-16	5/7/18	Arsenic (mg/kg)	2.4	0.21	43, pp.6850, 6851; 90, pp.6,52; 220, pp.36, 37
B9-SS04-01-050718	0-6”	Sandy loam	1805320-8	5/7/18	Uranium (mg/kg)	2.0	0.011	43, pp.6850, 6851; 90, pp.6,36; 220, pp.36, 37
BSA-9	0-6”	Sandy loam	1805319	5/7/18	Radium-226 (pCi/g)	1.94*	NA	43, pp.6850, 6851; 90, p.10; 200,

								p.1; 220, pp.30, 31
AOC Sample – Mesa I Mine 13 Waste Pile M6								
M6-XS224-01-091118	0-3”	Waste rock sand	1809473-34	9/11/18	Arsenic (mg/kg)	17	0.2	120, pp.6,88; 220, pp.611,613
M6-SS252-01-091618	0-6”	Silty sand	1809479-5	9/16/18	Uranium (mg/kg)	36	0.0092	6, p.257; 154, pp.7,51; 220, p.868
M6-SS252-01-091618	0-6”	Silty sand	1809480-5	9/16/18	Radium-226 (pCi/g)	23	NA	6, p.257; 154, pp.12,166; 220, pp.676,677

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 5

Name of AOC: Mesa I Mine 14 Waste Pile M7A, Waste Pile M7B, and Waste Pile M7C

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 4

AOC 5 comprises three waste piles: Mesa I Mine 14 Waste Pile M7A, Waste Pile M7B, and Waste Pile M7C. All three waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history (Ref. 7, p.32). Both Waste Pile M7A and Waste Pile M7B are on a slope greater than 30 degrees and 3 to 5 feet deep (Ref. 7, pp.32,34). Both waste piles are highly erodible, and offsite migration has been documented down the cliff below these piles. A waste pile discovered down the cliff below Waste Piles M7A and M7B was designated as Waste Pile M7C (Ref. 7, pp. 32,33). Waste Pile M7C is an extension of Waste Piles M7A and M7B and sits directly within the Cove Wash Middle 3E drainage (Ref. 7, p.33). The waste in AOC 5 was generated as a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 7, pp.24,25). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The workings for Mesa I Mine 14 extend northeast of the mine (Ref. 7, p.28,29).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is

three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs: 7, p.36; 43, p.960). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-9 was selected as the most appropriate background location for AOC 5 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC in the same geology and soil type (Ref. 43, pp. 45,46,940,943). The highest background concentration for each metals analyte from the 30 samples comprising BSA-9 was used as the background level for AOC 5 (Ref. 43, p. 963). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-9 was used as the background level for AOC 5 (Refs. 43, pp. 966; 200, p. 2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 96, pp.2,28,36; 156, pp.2,50). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 96, pp.2,69,77).

Table 8. Sample Description and Analytical Results for AOC 5

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 9)								7, p.36; 43, pp.960, 961, 962
B9-SS04-01-050718	0-6”	Sand	1805320-8	5/7/18	Lead (mg/kg)	6.3	0.21	43, pp.6850, 6821; 90, pp.6, 36; 220, pp.36, 37
B9-SS04-01-050718	0-6”	Sand	1805320-8	5/7/18	Uranium (mg/kg)	2.0	0.011	43, pp.6850, 6851; 90, pp.6,36; 220, pp.36, 37
BSA-9	0-6”	Sandy loam	1805319	5/7/18	Radium-226 (pCi/g)	1.94*	NA	43, pp.6850, 6851; 200, p.1; 90, p.10; 220, p.30
AOC Samples (Mesa I Mine 14 Waste Pile M7A)								
M7-SS161-01-091618	0-6”	Waste Rock	1809453-7	9/16/18	Lead (mg/kg)	20	0.2	7, p.223; 156, p. 50; 220, pp.879, 880
M7-XS162A-01-081518	0-3”	Waste rock sand	1808356-5	8/15/18	Uranium (mg/kg)	270	0.097	96, pp.5,28; 220, pp.427, 428

Table 8. Sample Description and Analytical Results for AOC 5								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
M7-XS162A-01-081518	0-3”	Waste rock sand	1808360-5	8/15/18	Radium-226 (pCi/g)	195 M3	NA	96, pp.9,69; 220, pp.432, 433
AOC Sample (Mesa I Mine 14 Waste Pile M7B and Waste Pile M7C)								
M7-XS235A-01-081418	0-3”	Waste rock sand	1808356-9	8/14/18	Uranium (mg/kg)	140	0.099	96, pp.5,36; 220, pp.427, 428
M7-XS235A-01-081418	0-3”	Waste rock sand	1808360-9	8/14/18	Radium-226 (pCi/g)	108 M3	NA	96, pp.5,77; 220, pp.432, 433

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC (Ref. 96, p. 77).

Number by which this AOC is to be identified: 6

Name of AOC: Mesa I Mine 15 Burial Cell 6a, Burial Cell 6b, Burial Cell 7, Waste Pile M8A, and Waste Pile M8B

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 4

AOC 6 comprises five waste piles: Mesa I Mine 15 Waste Pile M8A, Waste Pile M8B, Burial Cell 6a, Burial Cell 6b, and Burial Cell 7 (Ref. 8, pp.33,34). All five piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, same ore body, impacts on the same targets, and similar past operational history (Ref. 8, pp.33,34). Both Waste Pile M8A and Waste Pile M8B are approximately 2 feet deep on a slope greater than 30 degrees in places. Waste Piles M8A and M8B are highly erodible, and offsite migration likely flows downgradient to the Cove Wash Middle 3F drainage (Ref. 8, p.33). Burial Cells 6a and 6b are adjacent to each other and located southeast of Waste Pile M8B (Ref. 8, p.34). Burial Cell 7 lies within and is comingled with Waste Pile M8B (Ref. 8, p.34). The waste generated in AOC 6 is the result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 8, pp.24, 25). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The workings for Mesa I Mine 15 extend into Mesa I Mine 11 (Ref. 8, pp. 28, 29).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs: 8, p.36; 43, p.960). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-9 was selected as the most appropriate background location for AOC 6 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 43, pp. 45,46,940,943). The highest background concentration for each metals analyte from the 30 samples comprising BSA-9 was used as the background level for AOC 6 (Ref. 43, p. 963). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-9 was used as the background level for AOC 6 (Refs. 43, pp. 966; 200, p. 2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 97, pp.2,113,127; 154, pp.2,117; 157, pp.2,36). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 97, pp.2,208; 157, pp.2,76).

Table 9. Sample Description and Analytical Results for AOC 6

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 9)								8, p.36; 43, p.962
B9-SS04-01-050718	0-6”	Sandy loam	1805320-8	5/7/18	Uranium (mg/kg)	2.0	0.011	43, pp.6850, 6851; 90, pp.6,36; 220, pp.36, 37
BSA-9	0-6”	Sandy loam	1805319	5/7/18	Radium-226 (pCi/g)	1.94*	NA	43, pp.6850, 6851; 90, p.10; 200, p.1; 220, p.30
AOC Sample – Mesa I Mine 15 Waste Pile M8A								
M8-SS120-01-092718	0-6”	Silty sand	1810077-48	9/27/18	Uranium (mg/kg)	46	0.0098	8, p.230; 97, pp.6,127; 220, pp.781, 783
M8-SS106-01-092718	0-6”	Silty sand	1810076-39	9/27/18	Radium-226 (pCi/g)	12.2	NA	8, p.228; 97, pp.15,208; 220, pp.771, 773

Table 9. Sample Description and Analytical Results for AOC 6								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
AOC Sample – Mesa I Mine 15 Waste Pile M8B, Burial Cell 6a, Burial Cell 6b, and Burial Cell 7								
M8-XS83-01-081418	0-3”	Waste rock sand	1808476-12	8/14/18	Uranium (mg/kg)	180	0.095	157, pp.5,36; 220, pp.442, 443
M8-XS83-01-081418	0-3”	Waste rock sand	1808475-12	8/14/18	Radium-226 (pCi/g)	139 M3	NA	157, pp.9,76; 220, pp.437, 438

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC (Ref. 157, p. 76).

Number by which this AOC is to be identified: 7

Name of AOC: Mesa I Camp Waste Pile T17A, Waste Pile T17B, and Burial Cell 310AB

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 4

AOC 7 comprises three waste piles: Mesa I Camp Waste Pile 17A, Waste Pile T17B, and Burial Cell 310AB (Ref. 41, pp.31,32). All three piles are aggregated into a single AOC because of their proximity, similar waste characteristics, same AOC type, same ore body, impacts on the same targets, and similar past operational history (Ref. 41, pp.31,32). Mesa I Camp was a former mining field camp on Mesa I where a consolidated reclamation burial cell is located (Ref. 41, pp.26,31). Waste Pile T17A is located east and upgradient of Burial Cell 310AB, and Waste Pile T17B is located west and downgradient of Burial Cell 310AB (Ref. 41, pp.22,32). A small drainage was identified on Waste Pile T17B (Ref. 41, p.31). Burial Cell 310AB consists of waste from Mesa I Mine 13 and Mesa I Mine 15 (Ref. 41, p.30). Subsurface soil sampling results estimated a waste depth of 3 feet at Waste Pile T17A and Waste Pile T17B and a depth of 4.5 feet at Burial Cell 310AB (Ref. 41, p.132). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 41, pp.23,24). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is

three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs: 41, p.34; Ref. 43, p.1276). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-12 was selected as the most appropriate background location for AOC 7 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC with the same geology and soil type (Ref. 43, pp. 45,46,1256,1259). The highest background concentration for each metals analyte from the 30 samples comprising BSA-12 was used as the background level for AOC 7 (Ref. 43, p. 1279). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-12 was used as the background level for AOC 7 (Refs. 43, pp. 1282; 200, p. 2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 144, pp.2,71; 148, pp.2,37). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 144, pp.2,124).

Table 10. Sample Description and Analytical Results for AOC 7

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 12)								41, p.34; 43, pp.1277, 1278
B12-SS13-01-050918	0-6”	Sand	1805324-17	5/9/18	Lead (mg/kg)	18	0.22	43, pp.6875, 6876; 145, pp.6,54; 220, pp.60, 61
B12-SS13-01-050918	0-6”	Sand	1805324-17	5/9/18	Uranium (mg/kg)	3.3	0.011	43, pp.6876, 6877; 145, pp.6,54; 220, pp.60, 61
BSA-12	0-6”	Sand	1805323	5/9/18	Radium-226 (pCi/g)	2.41*	NA	43, pp.6876, 6877; 200, p.2; 145, p.10; 220, p.54
AOC Samples – Mesa I Camp Waste Pile T17A, Waste Pile T17B, and Burial Cell 310AB								
T17-XS144-01-042618	0-3”	Waste rock sand	1805039-9	4/26/18	Lead (mg/kg)	120	0.22	148, pp.5, 37; 220, pp.884, 885
T17-SS143-01-092518	0-6”	Silty sand	1810001-19	9/25/18	Uranium (mg/kg)	410	0.99	41, p.388; 144, pp.6, 71; 220, pp.686, 687

Table 10. Sample Description and Analytical Results for AOC 7								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
T17-SS143-01-092518	0-6”	Silty sand	1810002-19	9/25/18	Radium-226 (pCi/g)	166 M3	NA	41, p.388; 144, p.13, 124; 220, pp.692, 693

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC (Ref. 144, p. 124).

Number by which this AOC is to be identified: 8

Name of AOC: Mesa I 1/4 Mine Waste Pile M9

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 4

AOC 8 comprises one waste pile: Mesa I 1/4 Mine Waste Pile M9. Waste Pile M9 is approximately 1 foot deep (Ref. 9, p.30). Waste Pile M9 extends down into the Cove Wash Middle 3E drainage and has potential for erosion because of the steep topography (Ref. 9, pp.30,31,130). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 41, pp.22,23). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs: 9, p.33; 43, p.1382). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-13 was selected as the most appropriate background location for AOC 8 because it is within the same geologic unit (lower Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 43, pp.45,46,1362,1365). The highest background concentration for each metals analyte from the 30 samples comprising BSA-13 was used as the background level for AOC 8 (Ref. 43, p. 1385). The Ra-226 mean

plus two standard deviations from the 30 samples comprising BSA-13 was used as the background level for AOC 8 (Refs. 43, pp. 1388; 200, p. 2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 99, pp.2,35). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 99, pp.2,78).

Table 11. Sample Description and Analytical Results for AOC 8

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 13)								9, p.33; 43, p.1384
B13-SS23-01-071518	0-6”	Silty sand	1807350-26	7/15/18	Uranium (mg/kg)	0.85	0.011	43, pp.6884, 6885; 88, pp.6,71; 220, pp.361, 362
BSA-13	0-6”	Silty sand	1807351	7/15/18	Radium-226 (pCi/g)	1.54*	NA	43, pp.6884, 6885; 200, p.2; 88, p.10; 220, p.369
AOC Sample – Mesa I 1/4 Mine Waste Pile M9								
M9-XS28A-01-081718	0-3”	Waste rock sand	1808483-9	8/17/18	Uranium (mg/kg)	150	0.093	99, pp.5,35; 220, pp.447, 448
M9-XS28A-01-081718	0-3”	Waste rock sand	1808484-9	8/17/18	Radium-226 (pCi/g)	110 J-	NA	48, pp.7,8; 99, pp.8,78; 220, pp.452, 453

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

J- The analyte was detected at the reported concentration; the quantitation is an estimate and may be biased low. As a source sample, the concentration of this qualified data is reported without adjustment (Ref. 48, p.7, 8).

Number by which this AOC is to be identified: 9

Name of AOC: Mesa I 1/2 Mine Waste Pile M10A and Waste Pile M10B

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 4

AOC 9 comprises two waste piles: Mesa I 1/2 Mine Waste Pile M10A and Waste Pile M10B. Both waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, similar past operational history, impacts on the same targets, and because Waste Pile M10A is the result of waste falling from Waste Pile M10B over a cliff and accumulating below. Waste Pile M10A extends into the Cove Wash Middle 3E drainage (Ref. 10, pp.29,30). Waste Pile M10B is north and upgradient of Waste Pile M10A (Ref. 10, p.31). Additional drainages run through the waste piles into the Cove Wash Middle 3E drainage (Ref. 10, p.31). Furthermore, the steep topography also presents a high potential for offsite migration into the Cove Wash Middle 3E drainage (Ref. 41, p.129). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 10, p.22). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs: 10, p.33; 43, p.1589). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-15 was selected as the most appropriate background location for AOC 9 because it is within the same geologic unit (undifferentiated Summerville and Entrada Formations), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 43, pp. 45,46,1567,1570). The highest background concentration for each metals analyte from the 30 samples comprising BSA-15 was used as the background level for AOC 9 (Ref. 43, p. 1590). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-15 was used as the background level for AOC 9 (Refs. 43, pp. 1593; 200, p. 2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 86, pp.2,29; 101, pp.2,92). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 152, pp.2,20).

Table 12. Sample Description and Analytical Results for AOC 9

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 15)								10, p.33; 43, p.1589
B15-SS11-01-	0-6”	Sand	1807264-16	7/11/18	Uranium (mg/kg)	1.7	0.01	43, p.6904; 100, pp.6,52;

Table 12. Sample Description and Analytical Results for AOC 9								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
071118								220, pp.295, 296
BSA-15	0-6”	Sand	1807265	7/11/18	Radium-226 (pCi/g)	1.33*	NA	43, pp.6900, 6901; 200, p.2; 100, p.10; 220, p.303
AOC Samples – Mesa I 1/2 Mine Waste Pile M10A and Waste Pile M10B								
M10-SS10-01-092818	0-6”	Silty sand	1810080-23	9/28/18	Uranium (mg/kg)	99	0.01	10, p.178; 101, pp.7,92; 220, pp.799, 800
M10-XS43-01-082118	0-3”	Waste rock sand	1808495-3	8/21/18	Radium-226 (pCi/g)	52.1	NA	152, pp.7,20; 220, pp.471, 472

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Areas of Observed Contamination 10 to 17 – Mesa II

Eight AOCs are scored as a result of mining activities at Mesa II.

Table 13. Mesa II AOCs			
AOC No.	**AOC Type**	**Mine/Claim Names**	**RSE Waste Pile Names**
10	Pile	Mesa I 1/2, West Mine	Waste Pile M12
11	Pile	Mesa I 3/4 Incline	Waste Pile M25; Burial Cells 31a and 31b
12	Pile	Mesa II, Mine No. 1, P-150; Mesa II, Mine No. 1 & 2, P-21; Mesa I 3/4, Mine No. 2, P150	Waste Piles M27 and M28; Burial Cell 39
13	Pile	Mesa II, Mine 4	Waste Piles M29A and M29B; Burial Cell 43
14	Pile	Mesa II Pit	Waste Pile M24; Burial Cell 44
15	Pile	Mesa II 1/4 Mine	CO-07_NNWP01 and CO-07_NNWP02
16	Pile	Henry Philips Mine	Waste Pile M11

Table 13. Mesa II AOCs			
AOC No.	**AOC Type**	**Mine/Claim Names**	**RSE Waste Pile Names**
17	Pile	Billy Topaha Mine	CO-03_CAWP01

All mine claims in the Mesa II geographic area except Henry Philips Mine and Mesa II ¼ Mine were developed and operated in the 1950s and 1960s by F.A. Sitton, the Navajo Uranium Mining Company, Kerr-McGee (a predecessor of Tronox), and VCA (Refs. 11, p.24; 12, p.24; 24, p.25; 25, p.26; 27, p.25; 28, p.25; 29, p.25). The Henry Philips Mine and Mesa II 1/4 Mine were developed in the 1960s by Cyprus Amax, a successor of the Climax Uranium Corporation and VCA (Refs. 82, p.2; 83, p.2). Operations at all mines included underground mining that tapped paleochannels in the Salt Wash Member of the Lower Morrison Formation that are rich in uranium and vanadium (Refs. 11, pp.21,24; 12, pp.21; 24, pp.22,25; 25, pp.23,26; 27, pp.22,25; 28, pp.22,25; 29, pp.22,25; 82, pp.1,5; 83, pp.1,5). Underground mine workings exist throughout the Mesa II area. Waste piles consist of overburden or lower grade protore discarded near or downslope of portals (Refs. 11, pp.27,28; 12, pp.24,28; 24, pp.30,31; 25, pp.27,28,32,33; 27, pp.26,27,31,32; 28, pp.26,29,30; 29, pp.29,30; 82, pp.2,4,5; 83, pp.2,4).

Number by which this AOC is to be identified: 10

Name of AOC: Mesa I 1/2, West Mine Waste Pile M12

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 5 and Figure 6

AOC 10 comprises one waste pile: Mesa I 1/2, West Mine Waste Pile M12. The Cove Wash Middle 3D drainage cuts through Waste Pile M12. At the bottom of the drainage is a large waterfall with a vertical drop estimated over 75 feet (Ref. 12, pp.24,25). The onsite drainage eventually connects to the Cove Wash Middle 3A drainage (Ref. 12, pp.18,19). Waste Pile M12 is highly erodible, and offsite waste migration has been documented. Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the background samples from the AOC-specific background study area (Ref. 12, p.31; Ref. 43, p.1483). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-14 was selected as the most appropriate background location for AOC 10 because it is within the same geologic unit (lower Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 43, pp. 45,46,1463,1466). The highest background concentration for each metals analyte from the 30 samples comprising BSA-14 was used as the background level for AOC 10 (Ref. 43, p. 1486). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-14 was used as the background level for AOC 10 (Refs. 43, pp. 1489; 200, p. 2). The metals analysis was performed by ALS Environmental Laboratories using

USEPA method SW-846 6020A ICP-MS (Ref. 101, pp.2,106). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 86, pp.2,73).

Table 14. Sample Description and Analytical Results for AOC 10

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Samples (BSA 14)								12, p.31; 43, p.1485
B14-SS15-01-071518	0-6”	Silty sand	1807353-18	7/15/18	Uranium (mg/kg)	0.55	0.011	43, p.6896; 102, pp.6,54; 220, pp.375, 376
BSA-14	0-6”	Silty loam	1807354	7/15/18	Radium-226 (pCi/g)	0.8*	NA	43, p.6892, 6893; 200, p.2; 102, p.10; 220, p.383
AOC Samples – Mesa I 1/2 West Mine Waste Pile M12								
M12-SS33-01-092818	0-6”	Silty sand	1810080-30	9/28/18	Uranium (mg/kg)	6.7	0.0091	12, p.180; 101, pp.7,106; 220, pp.799, 800
M12-XS27-01-071518	0-3”	Waste rock sand	1807370-6	7/15/18	Radium-226 (pCi/g)	5.22	NA	86, pp.9,73; 220, pp.413, 414

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 11

Name of AOC: Mesa I 3/4 Incline Waste Pile M25, Burial Cell 31a, and Burial Cell 31b

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 5 and Figure 6

AOC 11 comprises three waste piles: Mesa I 3/4 Incline Waste Pile M25, Burial Cell 31a, and Burial Cell 31b.

All three piles are aggregated into a single AOC because of their proximity, similar waste characteristics, same AOC type, same ore body, impacts on the same targets, and similar past operational history. Waste Pile M25, Burial Cell 31a, and Burial Cell 31b are near one other in the southeastern portion of the mine and are the result of the same mining operations. AOC 11 is approximately 3 feet deep (Ref. 25, pp.32,33). A drainage bisects the mine area and Waste Pile M25 and connects to the Cove Wash Middle 3C drainage (Ref. 25, pp.19,21). Waste Pile M25 is erodible, and offsite waste migration has been documented to flow into the Cove Wash Middle 3C drainage. Onsite waste was placed into Burial Cells 31a and 31b (Ref. 25, p.133). As a part of the reclamation process, NAML placed 1.5 feet of cover material over both Burial Cell 31a and Burial Cell 31b in 2001. In addition, a 230-foot diversion berm was constructed to divert water away from Burial Cell 31b (Ref. 25, p.30). The waste is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation (Ref. 25, pp.23,24,26). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The workings of Mesa I 3/4 Incline extend to Mesa II, Mine No, 1 & 2, P-21 (Ref. 25, pp.27,28).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 25, p.35; 43, p.3035). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-30 was selected as the most appropriate background location for AOC 11 because it is within the same geologic unit (lower Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 43, pp. 45,46,3015,3018). The highest background concentration for each metals analyte from the 30 samples comprising BSA-30 was used as the background level for AOC 11 (Ref. 43, p.3038). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-30 was used as the background level for AOC 11 (Refs. 43, pp.3041; 200, p. 2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 101, pp.2,124). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 101, pp.2,227).

Table 15. Sample Description and Analytical Results for AOC 11

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 30)								25, p.35; 43, p.3035,3037
B30-SS19-01-071018	0-6”	Sand	1807262-22	7/10/18	Arsenic (mg/kg)	2.1	0.2	43, p.7025; 126, pp.6,64; 220, pp.279, 280
B30-SS30-01-071018	0-6”	Sand	1807262-34	7/10/18	Uranium (mg/kg)	0.67	0.0091	43, p.7026; 126, pp.6,88; 220, pp.279, 281

Table 15. Sample Description and Analytical Results for AOC 11								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
BSA-30	0-6"	Sand, sandy loam, silty sand	1807263	7/10/18	Radium-226 (pCi/g)	0.89*	NA	43, pp.7020, 7021; 200, p.2; 126, p.10; 220, p.287
AOC Sample – Mesa I 3/4 Incline Waste Pile M25, Burial Cell 31a, and Burial Cell 31b								
M25-SS50-01-092818	0-6"	Silty sand	1810080-39	9/28/18	Arsenic (mg/kg)	7.4	0.19	25, p.185; 101, pp.7,124; 220, pp.799, 801
M25-SS50-01-092818	0-6"	Silty sand	1810080-39	9/28/18	Uranium (mg/kg)	43	0.0097	25, p.185; 101, pp.7,124; 220, pp.799, 801
M25-SS50-01-092818	0-6"	Silty sand	1810079-39	9/28/18	Radium-226 (pCi/g)	31.6	NA	25, p.185; 101, p.11,227; 220, pp.791, 793

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 12

Name of AOC: Mesa I 3/4, Mine No. 2, P-150, and Mesa II, Mine No. 1 & 2, P-21, Waste Pile M27 and Burial Cell 39; Mesa II, Mine No. 1, P-150, Waste Pile M28

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 5 and Figure 6

AOC 12 comprises three waste piles: Mesa I 3/4, Mine No. 2, P-150, and Mesa II, Mine No. 1 & 2, P-21, Waste Pile M27 and Burial Cell 39, and Mesa II, Mine No. 1, P-150, Waste Pile M28. These waste piles are aggregated into a single AOC because of their proximity, same AOC type, impacts on the same targets, wastes eroding into the same drainage, and wastes coming from the same ore body with interconnected underground workings (Refs. 27, pp.31,32; 28, pp.29,30). Waste Pile M27 is approximately 2 feet deep on a slope of approximately 35 degrees

(Ref. 27, p.31). Burial Cell 39 is located adjacent to Waste Pile M27. Burial Cell 39 appears as a vegetated landform with a channel incision and is being eroded by the Cove Wash Middle 3B drainage. The incised channel reaches depths of more than 5 feet within Burial Cell 39 (Ref. 27, pp.31,32). Waste Pile M28 is approximately 5 feet deep on a slope greater than 45 degrees in areas. Waste Pile M28 is highly erodible, and offsite migration has been documented (Ref. 28, pp.29,130). All waste piles are connected or extend into the nearby Cove Wash Middle 3B drainage (Refs. 27, p.32; 28, p.30). The waste is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation (Refs. 27, pp.22,23; 28, pp.22,23). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The workings at Mesa II Mine No. 1 & 2, P-21, extend to Mesa II Mine No. 1, P-150, and Mesa I 3/4 Incline (Refs. 25, pp.27,28; 27, p.27). The workings at Mesa II Mine No. 1 & 2, P-21, also extent to Mesa II 1/2 Mine located west of the Mesa II area (Ref. 30, p.28).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study areas (Refs. 27, p.34; 43, p.1066; 28, p.32; 43, p.2515). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

Because AOC 12 waste piles are spread across two geologies, two separate BSAs are used for different parts of the AOC. For Mesa II Mine No. 1 & 2, P-21 Waste Pile M27 and Mesa II Mine No. 1 & 2, P-21 Burial Cell 39, both BSA-10 and BSA-30 were deemed appropriate background locations because they are within the same geologic unit (undifferentiated Summerville and Entrada Formations) and they host soil of the similar types (Refs., 43, pp. 1046,3015; 27, p. 22). BSA-10 was selected as the BSA to establish background levels for the three hazardous substances scored in these two waste piles because it has higher background concentrations than BSA-30 (Ref. 43, pp.1069,1072,3038,3041). The highest background concentration for each metals analyte from the 30 samples comprising BSA-10 was used as the background level for Waste Pile M27 and Burial Cell 39 (Ref. 43, p.1069). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-10 was used as the background level for Waste Pile M27 and Burial Cell 39 (Ref. 200, p.2).

For the Mesa II Mine No. 1, P-150 Waste Pile M28 waste pile, BSA-24 and BSA-29 were both found to be appropriate BSAs. Mesa II Mine No. 1, P-150 Waste Pile M28 is partially within the Undifferentiated Summerville Entrada Formation and to a lesser degree within the Lower Morrison (Ref. 28, p. 22). BSA-24 was selected as the BSA to establish background levels for the three hazardous substances scored in these two waste piles because it has higher background concentrations than BSA-29 (Ref. 43, pp.2518,2521,2935,2938). The highest background concentration for each metals analyte from the 30 samples comprising BSA-24 was used as the background level for Waste Pile M28 (Ref. 43, p.2518). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-24 was used as the background level for Waste Pile M28 (Ref. 200, p.2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 129, pp.2,57; 130, pp.2,34; 129, pp.2,107). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 129, pp.2,149; 129, pp.2,199).

Table 16. Sample Description and Analytical Results for AOC 12								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
Background Sample (BSA 10)								27, p.34; 43, pp.1066, 1068
B10-SS27-01-050818	0-6”	Sandy loam	1805318-32	5/8/18	Arsenic (mg/kg)	19	0.21	43, pp.6858, 6859; 131, pp.6,83;220, pp.24, 26
B10-SS15-01-050818	0-6”	Sandy loam	1805318-19	5/8/18	Uranium (mg/kg)	6.3	0.011	43, pp.6858, 6859; 131, pp.6,57; 220, pp.24, 25
BSA-10	0-6”	Sandy loam	1805317	5/8/18	Radium-226 (pCi/g)	6.04*	NA	43, pp.6858, 6859; 200, p.1; 131, p.10; 220, p.18
AOC Sample – Mesa II Mine No. 1 & 2, P-21 Waste Pile M27								
M27-SS51-01-092618	0-6”	Silty sand	1810024-7	9/26/18	Uranium (mg/kg)	26	0.0094	27, p.216; 129, pp.7,57; 220, pp.710, 711
M27-SS51-01-092618	0-6”	Silty sand	1810025-7	9/26/18	Radium-226 (pCi/g)	51.8	NA	27, p.216; 129, pp. 15,149; 220, pp.718,719
AOC Sample – Mesa II Mine No. 1 & 2, P-21 Burial Cell 39								
M27-XSG28-01-092618	0-3”	Waste rock sand	1810072-6	9/26/18	Arsenic (mg/kg)	58	0.19	130, pp.6,34; 220, pp.755, 756
M27-XSG28-01-092618	0-3”	Waste rock sand	1810072-6	9/26/18	Uranium (mg/kg)	25	0.0097	130, pp.6, 34; 220, pp.755, 756
Background Sample (BSA 24)								28, p.32; 43, pp.2515, 2517
B24-SS26-01-071618	0-6”	Silty sand	1807365-29	7/16/18	Arsenic (mg/kg)	3.5	0.22	43, p.6982; 117, pp.6, 77; 220, pp.389, 390

Table 16. Sample Description and Analytical Results for AOC 12								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
B24-SS06-01-071618	0-6”	Silty sand	1807365-9	7/16/18	Uranium (mg/kg)	1.9	0.011	43, p.6980; 117, pp.6, 37; 220, pp.389, 390
BSA-24	0-6”	Silty sand	1807366	7/16/18	Radium-226 (pCi/g)	2.06*	NA	43, pp.6977, 6978; 200, p.2; 117, p.10; 220, p.395
AOC Sample – Mesa II Mine No. 1, P-150 Waste Pile M28								
M28-SS30-01-092618	0-6”	Silty sand	1810024-41	9/26/18	Arsenic (mg/kg)	12	0.18	28, p.200; 129, pp.7, 107; 220, pp.710, 712
M28-SS30-01-092618	0-6”	Silty sand	1810024-41	9/26/18	Uranium (mg/kg)	230	0.092	28, p.200; 129, pp.7, 107; 220, pp.710, 712
M28-SS30-01-092618	0-6”	Silty sand	1810025-32	9/26/18	Radium-226 (pCi/g)	127 M3	NA	28, p.200; 129, pp. 15,199; 220, pp.718, 720

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref. 129, p. 199).

Number by which this AOC is to be identified: 13

Name of AOC: Mesa II Mine 4 Waste Pile M29A, Waste Pile M29B, and Burial Cell 43

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 5 and Figure 6

AOC 13 comprises three waste piles: Mesa II Mine 4 Waste Pile M29A, Waste Pile M29B, and Burial Cell 43. These waste piles are aggregated into a single AOC because of their proximity, same AOC type, impacts on the

same targets, wastes eroding into the same drainage, and wastes coming from the same ore body with interconnected underground workings. Waste Piles M29A and M29B are 3 feet deep on average with slopes greater than 45 degrees. Burial Cell 43 is located against a highwall at the mine (Ref. 29, pp.29,30). Waste Pile M29A is located at the base of a sandstone cliff downgradient of Burial Cell 43. The material at Waste Pile M29A appears to be relatively confined. Waste Pile M29B is located below Burial Cell 43 on a steeper slope where potential for erosion is likely (Ref. 29, p.129). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation. Minor drainages run through the waste piles and connect to the Cove Wash Middle 3A drainage located downgradient of the mine (Ref. 29, pp.30,135). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater (Ref. 223, p. 20).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Ref. 29, p.32; 43, p.2515). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-24 was selected as the most appropriate background location for AOC 13 because it is within the same geologic unit (undifferentiated Summerville and Entrada Formations), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 29, p.31). The highest background concentration for each metals analyte from the 30 samples comprising BSA-24 was used as the background level for AOC 13 (Ref. 43, p. 2518). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-24 was used as the background level for AOC 13 (Ref. 200, p.2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 129, pp.2,73; 133, pp.2,35). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 129, pp.2,165; 133, pp.2,75).

Table 17. Sample Description and Analytical Results for AOC 13

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 24)								29, p.32; 43, p.2517
B24-SS06-01-071618	0-6”	Silty sand	1807365-9	7/16/18	Uranium (mg/kg)	1.9	0.011	43, p.6980; 117, pp.6,37; 220, pp.389, 390
BSA-24	0-6”	Silty sand	1807366	7/16/18	Radium-226 (pCi/g)	2.06*	NA	43, pp.6977, 6978; 117, p.10; 200, p.4; 220, p.395
AOC Sample – Mesa II Mine 4 Waste Pile M29A and Burial Cell 43								

Table 17. Sample Description and Analytical Results for AOC 13								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
M29-SS48-01-092518	0-6”	Waste rock sand	1810024-15	9/25/18	Uranium (mg/kg)	23	0.01	29, p.177; 129, pp.7,73; 220, p.710
M29-SS48-01-092518	0-6”	Waste rock sand	1810024-15	9/25/18	Radium-226 (pCi/g)	21.6	NA	29, p.177; 129, p. 165; 220, pp.710, 711
AOC Sample – Mesa II Mine 4 Waste Pile M29B								
M29-XS19-01-092518	0-3”	Waste rock sand	1810032-9	9/25/18	Uranium (mg/kg)	11	0.0097	133, pp.5,35; 220, pp.745, 746
M29-XS19-01-092518	0-3”	Waste rock sand	1810033-9	9/25/18	Radium-226 (pCi/g)	9.3	NA	133, pp.8,75; 220, pp.750, 751

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 14

Name of AOC: Mesa II Pit Waste Pile M24 and Burial Cell 44

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 5 and Figure 6

AOC 14 comprises two waste piles: Mesa II Pit Waste Pile M24 and Burial Cell 44. Burial Cell 44 is located within and upgradient of Waste Pile M24. These waste piles are aggregated into a single AOC because of their proximity, wastes eroding into the same drainage, wastes coming from the same ore body, and the same mine opening. Waste Pile M24 is a surficial waste pile that is 2.5 feet deep on average on a slope greater than 30 degrees (Ref. 24, pp.30,31). The waste pile has high erosion potential with sparse vegetation, and three drainages cut through it (Ref. 24, pp.30,31,133). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation (Ref. 24, pp.22,23). The three onsite drainages connect to the Cove Wash Middle 3 drainage located downgradient of the mine (Ref. 24, pp.19,20). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater (Ref. 223, p.20).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 24, p.33; 43, p.2515). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-24 was selected as the most appropriate background location for AOC 14 because it is within the same geologic unit (undifferentiated Summerville and Entrada Formations), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 24, p.32). The highest background concentration for each metals analyte from the 30 samples comprising BSA-24 was used as the background level for AOC 14 (Ref. 43, p. 2518). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-24 was used as the background level for AOC 14 (Ref. 200, p.2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 127, pp.2,41; 158, pp.2,61). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 158, pp.2,98).

Table 18. Sample Description and Analytical Results for AOC 14

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 24)								24, p.33; 43, pp.2515, 2517
B24-SS26-01-071618	0-6”	Silty sand	1807365-29	7/16/18	Arsenic (mg/kg)	3.5	0.22	43, p.6982; 117, pp.6,77; 220, pp.389, 390
B24-SS06-01-071618	0-6”	Silty sand	1807365-9	7/16/18	Uranium (mg/kg)	1.9	0.011	43, p.6980; 117, pp.6,37; 220, pp.389, 390
BSA-24	0-6”	Silty sand	1807366	7/16/18	Radium-226 (pCi/g)	2.06*	NA	43, pp.6977, 6978; 200, p.2; 117, p.10; 220, p.395
AOC Samples – Mesa II Pit Waste Pile M24 and Burial Cell 44								
M24-SS76-01-092518	0-6”	Waste rock sand	1810003-14	9/25/18	Arsenic (mg/kg)	32	0.21	24, p.203; 158, pp.5,61; 220, p.698

Table 18. Sample Description and Analytical Results for AOC 14								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
M24-XS115-01-071418	0-3”	Waste rock sand	1807369-7	7/14/18	Uranium (mg/kg)	12	0.011	127, pp.5,41
M24-SS40-02-092518	0-6”	Waste rock sand	1810004-13	9/25/18	Radium-226 (pCi/g)	41.2 M3	NA	24, p.206; 158, pp.12,98; 220, pp.704, 705

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref. 158, p.98).

Number by which this AOC is to be identified: 15

Name of AOC: Mesa II 1/4 Mine Waste Pile CO-07-NNWP01 and Waste Pile CO-07-NNWP02

AOC Type: Piles

Location and description of AOC (with reference to a map of the area): Figure 5 and Figure 6

AOC 15 comprises two waste piles: Mesa II 1/4 Mine Waste Pile CO-07-NNWP01 and Waste Pile CO-07-NNWP02. These waste piles are aggregated into a single AOC because they are a continuation of the same pile over a cliff and the waste came from the same underground workings. Waste Pile CO-07-NNWP01 was consolidated during NAML reclamation efforts and is approximately 15 feet higher in elevation than Waste Pile CO-07-NNWP02 (Ref. 82, p.6). A diversion channel is located along the north side of Waste Pile CO-07-NNWP01 (Ref. 82, p.6). Waste Pile CO-07-NNWP02 was reported as unreclaimed and sits on a bench. Approximately 200 feet down slope of this bench, the mine area drops into a large sheer cliff band into a drainage in the northeast. The mine area is located on 20- to 35-degree slopes above the cliff band (Ref. 82, p.6). Two drainages are located within the Mesa II 1/4 Mine area. The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation. Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater (Ref. 223, p.20).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is

three times the highest background concentration. For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

The Morrison Formation BRA was chosen by Cyprus Amax to best represent the background levels for AOC 15 (Refs. 63, p.63; 82, p.8). The highest concentration of each metal analyte from all samples collected from the Morrison Formation BRA was chosen as the background level (Refs. 1, p.14, p.116; 82, p.6; 63, pp.63,65). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 167, pp.1467,1470). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 167, p.1615).

Table 19. Sample Description and Analytical Results for AOC 15

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Background – Morrison Formation)								82, p.6; Ref. 63, p.65
SS-CO-B1-021-10142017	0-6”	Unavailable	1710392-23	10/14/17	Uranium (mg/kg)	1.5	0.1	169, p.1401
Morrison Ra-226	0-6”	Unavailable	1710392	10/14/17	Radium-226 (pCi/g)	1.39*	NA	200, p.2
AOC Sample – Mesa II 1/4 Mine Waste Pile CO-07-NNWP01								
SS-07-NNWP01-001-10102	0-6”	Waste	1810331-16	10/10/18	Uranium (mg/kg)	9.1	0.012	167, p.1470
AOC Sample – Mesa II 1/4 Mine Waste Pile CO-07_NNWP02								
SS-07-NNWP02-001-10102	0-6”	Waste rock sand	1810331-13	10/10/18	Uranium (mg/kg)	6.8	0.0096	167, p.1467
SS-07-NNWP02-001-10102	0-6”	Waste rock sand	1810331-13	10/10/18	Radium-226 (pCi/g)	4.85	NA	167, p.1615

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 16

Name of AOC: Henry Phillips Mine Waste Pile M11

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 5 and Figure 6

AOC 16 comprises one waste pile: Henry Phillips Mine Waste Pile M11. This waste pile is 2 to 3 feet deep with a slope greater than 50 percent in places (Ref. 11, p.27). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation (Ref. 11, pp.21,22). The waste pile drains to the Cove Wash Middle 3A drainage. Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater (Ref. 223, p.20).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 11, p.30; 43, p.1483). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-14 was selected as the most appropriate background location for AOC 16 because it is within the same geologic unit (lower Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Refs. 11, p.19; 43, pp. 45,46,1463). The highest background concentration for each metals analyte from the 30 samples comprising BSA-14 was used as the background level for AOC 16 (Ref. 43, p. 1486). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-14 was used as the background level for AOC 10 (Ref. 200, p.2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 86, pp.2,35; 91, pp.2,99). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 86, pp.2,69).

Table 20. Sample Description and Analytical Results for AOC 16

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 14)								11, p.30; 43, p.1485
B14-SS15-01-071518	0-6”	Silty sand	1807353-18	7/15/18	Uranium (mg/kg)	0.55	0.011	43, p.6896; 102, pp.6,54; 220, pp.375, 376
BSA-14	0-6”	Silty sand	1807354	7/15/18	Radium-226 (pCi/g)	0.8*	NA	43, pp.6892, 6893; 102, p.10; 200,

Table 20. Sample Description and Analytical Results for AOC 16								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
								p.2; 220, p.383
AOC Sample – Henry Phillips Mine Waste Pile M11								
M11-XS11-01-071118	0-3”	Waste rock sand	1807369-4	7/11/18	Uranium (mg/kg)	230	0.098	86, pp.5,35
M11-XS11-01-071118	0-3”	Waste rock sand	1807370-4	7/11/18	Radium-226 (pCi/g)	191 M3	NA	86, pp.9,69; 220, pp.413, 414

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref. 86, p.69).

Number by which this AOC is to be identified: 17

Name of AOC: Billy Topaha Mine Waste Pile CO-03-CAWP01

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 5 and Figure 6

AOC 17 comprises one waste pile: Billy Topaha Mine Waste Pile CO-03-CAWP01. This sparsely vegetated waste pile is located along the main bench in the southeast portion of the mine area with residual waste rock extending into an inaccessible area (Ref. 83, p.4). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison (Ref. 83, p.5). The waste pile drains to the eastern branch of the Cove Wash Middle 3A drainage. Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 83, p.6; 63, p.65). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above

the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

The Morrison Formation BRA was chosen by Cyprus Amax to best represent the background levels for AOC 15 (Refs. 63, p.63; 82, p.8). The highest concentration of each metal analyte from all samples collected from the Morrison Formation BRA was chosen as the background level (Ref. 63, p.63). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 168, pp.79,1351). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 168, p.404).

Table 21. Sample Description and Analytical Results for AOC 17

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Background – Morrison Formation)								83, p.6; 63, p.65
SS-CO-B1-008-10142017	0-6”	Unavailable	1710392-9	10/14/17	Arsenic (mg/kg)	2.2	0.2	169, pp.5, 1387
SS-CO-B1-021-10142017	0-6”	Unavailable	1710392-23	10/14/17	Uranium (mg/kg)	1.5	0.01	169, pp.5, 1401
Morrison Ra-226	0-6”	Unavailable	1710392	10/14/17	Radium-226 (pCi/g)	1.39*	NA	200, p.2;
AOC Samples - Billy Topaha Mine Waste Pile CO-03_CAWP01								
SS-03-MS-002-11102017	0-6”	Waste	1711255-1	11/10/17	Arsenic (mg/kg)	9.77 (17J)	0.21	168, p.7,79; 48, p.20
SS-03-CAWP01-002-09212018	0-6”	Waste	1809485-13	9/21/18	Uranium (mg/kg)	360	0.097	168, pp.,1351
SS-03-MS-002-11102017	0-6”	Waste	1711255-1DUP	11/10/17	Radium-226 (pCi/g)	254 M3	NA	168, pp.7,404

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

J The analyte was detected at the reported concentration; the quantitation is an estimate with unknown bias. As a result, the concentration of this qualified data has been adjusted (Ref. 48, p. 7, 8).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref. 168, p. 404).

Areas of Observed Contamination 18 to 21 – Mesa III

The Mesa III area includes four AOCs located at five mines.

Table 22. Mesa III AOCs			
AOC No.	**AOC Type**	**Mine Claim Names**	**RSE Waste Pile Names**
18	Pile	Mesa II 1/2 Mine	Waste Pile M30; Burial Cell 48
19	Pile	Mesa III Mine; Mesa II 1/2 Mine 4	Waste Piles M31 and M32
20	Pile	Mesa III Northwest Mine	CO-08 CAWP01
21	Pile	Mesa III West Mine	CO-09_NNWP01

The mines in the Mesa III area were developed and operated in the 1950s and 1960s by F.A. Sitton, the Navajo Uranium Mining Company, Kerr-McGee (a predecessor of Tronox), and VCA. Operations included underground mining that tapped paleochannels in the Salt Wash Member of the Lower Morrison Formation that are rich in uranium and vanadium (Refs. 30, pp.23,30; 31, pp.23,26; 32, pp.24,27; 80, pp.1,5; 81, pp.1,5). Underground mine workings exist throughout the Mesa III area. Waste piles consist of overburden or lower grade protore discarded near or downslope of portals (Refs. 30, pp.27,28,32; 31, pp.27,31; 32, pp.28,29,33; 80, p.4; 81, p.4).

Number by which this AOC is to be identified: 18

Name of AOC: Mesa II 1/2 Mine Waste Pile M30 and Burial Cell 48; NA-0313

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 7 and Figure 8

AOC 18 comprises two waste piles: Mesa II 1/2 Mine Waste Pile M30 and Burial Cell 48. The two waste piles are aggregated together into a single AOC because the waste is from the same mine operation and workings. Waste Pile M30 is approximately 7.5 feet deep on a slope greater than 45 degrees. Waste Pile M30 contains larger boulders and is highly erodible with a fork of the Cove Wash Middle 2B drainage running directly through it (Ref. 30, pp.32,33). The waste pile extends into NA-0313, a nearby mine-related feature that is an area of concern for future investigation. Offsite migration at Waste Pile M30 has been documented and likely flows down to the Cove Wash Middle 2B drainage north of the mine (Ref. 30, p.133). Reclamation work was performed at Mesa II 1/2 Mine in 2001 by NAML as part of the NA-0313 Cove 3 Phase II reclamation project. Waste material was excavated and placed into Burial Cell 48 and covered with 1.5 feet of nearby borrow material. The burial cell is located upgradient of Waste Pile M30 (Ref. 30, pp.30,33). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation (Ref. 30, pp.23,24). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The underground workings of Mesa II 1/2 Mine connect to the workings at Mesa I 3/4 Incline and Mesa II Mine No. 1 & 2, P-21, beneath the mesa (Refs. 25, pp.27,28; 27, p.27; 30, p.28).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is

three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 30, p.35; 43, p.3035). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-30 was selected as the most appropriate background location for AOC 18 because it is within the same geologic unit (lower Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 43, pp. 45,46,3015,3018). The highest background concentration for each metals analyte from the 30 samples comprising BSA-30 was used as the background level for AOC 18 (Ref. 43, p.3038). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-30 was used as the background level for AOC 18 (Ref. 200, pp.2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 86, pp.2,43; 91, pp.2,55). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 86, pp.2,77).

Table 23. Sample Description and Analytical Results for AOC 18

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 30)								30, p.35; 43, pp. 3035, 3037
B30-SS19-01-071018	0-6”	Sand	1807262-22	7/10/18	Arsenic (mg/kg)	2.1	0.2	43, p.7025; 126, pp.6, 64; 220, pp.279,280
B30-SS30-01-071018	0-6”	Sand	1807262-34	7/10/18	Uranium (mg/kg)	0.67	0.0091	43, p.7026; 126, pp.6, 88; 220, pp.279,281
BSA-30	0-6”	Sand	1807263	7/10/18	Radium-226 (pCi/g)	0.89*	NA	43, pp. 7020, 7021; 200, p.2; 126, p.10; 220, p.287
AOC Samples – Mesa II ½ Mine Waste Pile M30 and Burial Cell 48; NA-0313								
M30-SS167-01-092918	0-6”	Silty sand	1810124-3	9/29/18	Arsenic (mg/kg)	7.8	0.19	30, p.219; 91, pp.7, 55; 220, pp.824, 825
M30-XS127-01-071618	0-3”	Waste rock sand	1807369-9	7/16/18	Uranium (mg/kg)	360	0.1	86, pp.5,43

Table 23. Sample Description and Analytical Results for AOC 18								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
M30-XS127-01-071618	0-3”	Waste rock sand	1807370-9	7/16/18	Radium-226 (pCi/g)	115 M3	NA	86, pp.9,77; 220, p.413

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref 86, p.77).

Number by which this AOC is to be identified: 19

Name of AOC: Mesa II 1/2, Mine 4 Waste Pile M31; Mesa III Mine Waste Pile M32

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 7 and Figure 8

AOC 19 comprises two waste piles: Mesa II 1/2, Mine 4 Waste Pile M31 and Mesa III Mine Waste Pile M32. The two waste piles are aggregated into a single AOC because they abut one another, have similar waste characteristics, and are the result of mining the same mine workings. Waste Pile M31 is vegetated; however, a small drainage bisects a section of the waste pile and continues through to the Mesa III Mine and subsequently into the headwaters of the Cove Wash Middle 2B drainage (Refs. 31, pp.31,32; 32, pp.33,34). Offsite migration of contaminants from Waste Pile M32 into the Cove Wash Middle 2B drainage was observed. Mesa II 1/2, Mine 4 is upgradient of Mesa III Mine and is likely a contributor to contaminant migration seen at both mines (Refs. 31, p.32; 32, p.135). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation. Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The underground workings of Mesa III Mine extend northwest of the mine (Refs. 31, p.32; 32, pp.28,29).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 31, p.34; 32, p.36; 43, pp.3035,3142). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-30 was selected as the most appropriate background location for Mesa II 1/2, Mine 4 Waste Pile M31 because it is within the same geologic unit (lower Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Ref. 31, p. 33). BSA-31 was selected as the most appropriate background location for Mesa III Mine Waste Pile M32 because it is within the same geologic unit (lower Morrison Formation), it hosts soil of the same type, which is different from Waste Pile M31 (Ref. 32, p. 35). The highest background concentration for each metals analyte from the 30 samples comprising each BSA was used as the background level for its respective AOC (Refs. 31, p.75; 32, p.78). It is important to note that all metals analytes in AOC samples exceed 3 times the highest analyte-specific background sample concentration from both BSAs. The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-30 and BSA-31 was used as the background level for Waste Piles M31 and M32, respectively (Ref. 200, pp.2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 91, pp.2,67,85). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 91, pp.2,180,198).

Table 24. Sample Description and Analytical Results for AOC 19

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 30)								31, p.34; 43, pp. 3035, 3037
B30-SS30-01-071018	0-6”	Silty sand	1807262-34	7/10/18	Uranium (mg/kg)	0.67	0.0091	43, p.7026; 126, pp.6,88; 220, pp. 279, 281
BSA-30	0-6”	Silty sand, sand	1807263	7/10/18	Radium-226 (pCi/g)	0.89*	NA	43, pp.7020, 7021; 200, p.2; 126, p.10; 220, p.287
AOC Sample – Mesa II 1/2, Mine 4 Waste Pile M31								
M31-SS37-01-092918	0-6”	Silty sand	1810124-9	9/29/18	Uranium (mg/kg)	27	0.0097	31, p.185; 91, pp.7,67; 220, pp. 824, 825
M31-SS37-01-092918	0-6”	Silty sand	1810125-9	9/29/18	Radium-226 (pCi/g)	11	NA	31, p.185; 91, pp.15,180; 220, pp. 834, 835
Background Sample (BSA 31)								32, p.36; 43, p.3144

Table 24. Sample Description and Analytical Results for AOC 19								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
B31-SS09-01-071318	0-6”	Sand	1807325-13	7/13/18	Uranium (mg/kg)	1	0.011	43, p.7031; 135, pp.6, 47; 220, pp.311, 312
BSA-31	0-6”	Silty sand	1807326	7/13/18	Radium-226 (pCi/g)	1.62*	NA	43, pp.7028, 7029; 135, p.11; 200, p.2; 220, p.319
AOC Sample – Mesa III Mine Waste Pile M32								
M32-SS89-01-092918	0-6”	Silty sand	1810124-18	9/29/18	Uranium (mg/kg)	440	0.099	32, p.210; 91, pp.7,85; 220, pp.824, 825
M32-SS89-01-092918	0-6”	Silty sand	1810125-18	9/29/18	Radium-226 (pCi/g)	141 M3	NA	32, p.210; 91, pp.15,198; 220, p.834

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref. 91, p. 198).

Number by which this AOC is to be identified: 20

Name of AOC: Mesa III, Northwest Mine Waste Pile CO-08_CAWP01

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 7 and Figure 8

AOC 20 comprises one waste pile: Mesa III, Northwest Mine Waste Pile CO-08_CAWP01. This waste pile is located near the center of a bench that runs through the south-central portion of the mine area and extends downslope into inaccessible areas. The mine is on 20- to 35-degree slopes and upgradient of the Cove Wash

Middle 2A drainage to the northwest (Ref. 80, p.4). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation. Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater (Ref. 223, p.20).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 80, p.5; 63, p.65). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

The Morrison Formation BRA was chosen by Cyprus Amax to best represent the background levels for AOC 20 (Refs. 63, p.63; 82, p.8). The highest concentration of each metal analyte from all samples collected from the Morrison Formation BRA was chosen as the background level (Ref. 63, p.63). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 165, pp.447). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 165, pp.547).

Table 25. Sample Description and Analytical Results for AOC 20

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Background – Morrison Formation)								80, p.5; 63, p.65
SS-CO-B1-021-10142017	0-6”	Unavailable	1710392-23	10/14/17	Uranium (mg/kg)	1.5	0.01	169, pp.5,1401
Morrison Ra-226	0-6”	Unavailable	1710392	10/14/17	Radium-226 (pCi/g)	1.39*	NA	200, p.2;
AOC Sample – Mesa III, Northwest Mine Waste Pile CO-08_CAWP01								
SS-08-CAWP01-001-06082	0-6”	Waste	1806287-8	6/8/18	Uranium (mg/kg)	480	0.099	165, pp.13,447
SS-08-CAWP01-001-06082	0-6”	Waste	1806287-8	6/8/18	Radium-226 (pCi/g)	158 M3	NA	165, pp.547

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).
M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref. 165, p. 547).

Number by which this AOC is to be identified: 21

Name of AOC: Mesa III, West Mine Waste Pile CO-09_NNWP01

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 7 and Figure 8

AOC 21 comprises one waste pile: Mesa III, West Mine Waste Pile CO-09_NNWP01. This waste pile is located on a small cut bench in the central portion of the mine area and extends into steep inaccessible areas. The mine is located on 20- to 45-degree slopes (Ref. 81, pp.4,5,21). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation. Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The Mesa III, West Mine sits upgradient of the Cove Wash Middle 2A drainage (Ref. 32, p.22).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 81, p.5; 63, p.65). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

The Morrison Formation BRA was chosen by Cyprus Amax to best represent the background levels for AOC 21 (Refs. 63, p.63; 82, p.8). The highest concentration of each metal analyte from all samples collected from the Morrison Formation BRA was chosen as the background level (Ref. 63, p.63). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 166, pp.125,524). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 166, p.451).

Table 26. Sample Description and Analytical Results for AOC 21

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Background – Morrison Formation)								81, p.5; 63, p.65
SS-CO-B1-008-10142017	0-6”	Unavailable	1710392-9	10/14/17	Arsenic (mg/kg)	2.2	0.2	169, p. 1387

Table 26. Sample Description and Analytical Results for AOC 21								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
SS-CO-B1-021-10142017	0-6”	Unavailable	1710392-23	10/14/17	Uranium (mg/kg)	1.5	0.01	169, p.1401
Morrison Ra-226	0-6”	Unavailable	1710392	10/14/17	Radium-226 (pCi/g)	1.39*	NA	200, p.2;
AOC Sample – Mesa III, West Mine Waste Pile CO-09_NNWP01								
SS-09-NNWP01-002-10152	0-6”	Waste	1810423-5	10/15/18	Arsenic (mg/kg)	10	0.22	166, p.13 ,524
SS-09-MS-005-10232017	0-6”	Waste	1710526-6	10/23/17	Uranium (mg/kg)	41	0.01	166, pp.13, 14,125
SS-09-MS-005-10232017	0-6”	Waste	1710526-6	10/23/17	Radium-226 (pCi/g)	62.4 M3	NA	166, pp.13,14, 451

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref. 166, p. 451).

Description of Areas of Concern – Mesa III

Given the interconnected nature of the ore bodies, similar mining processes, similar time frames of operation, and general geology of the LMMD site, the possible mining-related sources listed below are likely to be releasing hazardous substances to the Cove Wash drainages or exposing human or terrestrial sensitive environment targets. These other areas of concern will be evaluated during further investigation.

Table 27. Mesa III Other Areas of Concern	
Other Areas of Concern	**Description (Reference)**
Cov000	Cov000 is located slightly north and east of Mesa III, Northwest Mine (Figure 1). Cov000 inventory lists one rimstrip and one pit. No waste piles are recorded at Cov000. The mine was listed as operational in 1966 (Ref. 52, p. 4, 6). Weston Solutions Inc. (Weston) conducted a gamma scan in 2010, and the highest gamma measurement was 20,696 counts per minute (cpm). The highest background gamma level measured was 9,123 cpm (Ref. 52, p. 3, 9, 10).
Mesa IV, East Side	Mesa IV, East Side is located northwest of Mesa III Mine and southwest of Mesa III, Northwest Mine (Ref. 23, p. 20, 24). The mine sits upgradient of the Cove Wash Middle 2A drainage (Ref. 23, p. 20). The mine is listed as having two waste piles, one rimstrip, and one pit. A small waste pile is located in the western portion of the mine area, and a larger waste pile is located in the northern portion of the mine area. The northern waste pile extends south through the mine area and east over a steep cliff (Ref. 50, p. 4, 6). Weston conducted a gamma scan in 2010, and the highest gamma measurement was 119,566 cpm, which is significantly higher than the highest background gamma level measurement of 11,150 cpm (Ref. 50, p. 3, 10, 11).

Areas of Observed Contamination 22 to 28 – Mesa IV

The Mesa IV area includes seven AOCs located at 14 mines and mine-related areas.

Table 28. Mesa IV AOCs			
AOC No.	**AOC Type**	**Mine Claim Names**	**RSE Waste Pile Names**
22	Pile	Mesa IV Mine No. 1; Mesa IV Mine No. 3	Waste Piles M20A, M20B, M22A, M22B, M22C; Burial Cell 56
23	Pile	Mesa IV Mine No. 2	Waste Piles M21A, M21B, M21C, M21D, M21E, and M21F; Burial Cell 63
24	Pile	Mesa IV West Mine	Waste Pile M23; Burial Cell 70b
25	Pile	Mesa IV ¼ Mine	CO-10_NNWP01
26	Pile	South Portal, Frank No. 1 Mine; East Portal, Frank No. 1 Mine; North Portal, Frank No. 1 Mine; Frank No. 2; Mesa IV 1/2 Mine and Simpson 181; Mesa V Mine - 508	CO-05_NNWP14, CO-05_NNWP15. CO-05_NNWP16, CO-05_NNWP17, CO-05_NNWP18, and CO-05_NNWP19, CO-05_NNWP05, CO-05_NNWP06, CO-05_NNWP07, CO-05_NNWP08, CO-05_NNWP09, CO-05_NNWP10, CO-05_NNWP11, CO-05_NNWP12, and CO-05-NNWP13, CO-05_NNWP01, CO-05_NNWP02, CO-05_NNWP03, and CO-05_NNWP04, CO-06_NNWP01; Waste Piles M18 and M19; Burial Cells 86b and 87a
27	Pile	NA-0316	CO-11_NNWP01, CO-11_NNWP02, and CO-11_NNWP03
28	Pile	Cov087	Cov087 Waste Pile

All mines in the Mesa IV area were either developed and operated by F.A. Sitton, the Navajo Uranium Mining Company, Kerr-McGee and VCA or by the Climax Uranium Company in the 1950s and 1960s (Refs. 18, p.26; 19, p.27; 20, p.27; 21, p.26; 22, p.25; 23, p.25; 76, p.1; 77, p.1; 78, pp.1; 79, p.1). Two additional mine-related areas—Cov087 and Cov068—are also within the Mesa IV area. Operations included underground mining that tapped paleochannels in the Salt Wash Member of the Lower Morrison Formation that are rich in uranium and

vanadium (Refs. 18, pp.23,24; 19, pp.24,25; 20, pp.23,25; 21, pp.23,24; 22, pp.22,23; 23, pp.22,23; 76, pp.41,42,43,50,51,52; 77, pp.22,25; 78, pp.24,27; 79, pp.21,24). Underground mine workings exist throughout the Mesa IV area. Waste piles consist of overburden or lower grade protore discarded near or downslope of portals (Refs. 18, pp.27,30; 19, pp.28,32; 20, pp.29,33; 21, pp.27,31; 22, pp.26,29; 23, pp.26,30; 76, pp.41,42,43,50,51,52; 77, pp.22,25; 78, pp.24,27; 79, pp.21,24).

Number by which this AOC is to be identified: 22

Name of AOC: Mesa IV Mine No. 1 Waste Pile M20A, Waste Pile M20B, and Burial Cell 56; Mesa IV Mine No. 3 Waste Pile M22A, Waste Pile M22B, and Waste Pile M22C

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 9 and Figure 11

AOC 22 comprises six waste piles: Mesa IV Mine No. 1 Waste Pile M20A, Waste Pile M20B, and Burial Cell 56; and Mesa IV Mine No. 3 Waste Pile M22A, Waste Pile M22B, and Waste Pile M22C (Refs. 20, p.29; 22, p.26). All waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history. Within Mesa IV Mine No. 1, Waste Pile M20A is in the northeastern portion and Waste Pile M20B is in the southwestern portion. Waste Pile M20B is shallower than Waste Pile M20A. Drainage and erosional features are present on Waste Pile M20A. Both waste piles have potential to erode and transport material into the Cove Wash Middle 2A drainage in the canyon below. Burial Cell 56 is located below the highwall and contains material from Waste Pile M20A (Ref. 20, pp.29,33,137). Within Mesa IV Mine No. 3, Waste Pile M22A is in the eastern portion, Waste Pile M22B is in the center, and Waste Pile M22C is in the western portion. The highest portion of the mine is near Waste Pile M22C with the area sloping down and to the east. Drainages were mapped on Waste Pile M22A and Waste Pile M22B. Unreclaimed Waste Piles M22a and M22B have the potential to erode and transport material into the Cove Wash Middle 2A drainage located east and downgradient of the mine. Waste Pile M22C is eroding into the Cove Wash Middle 1G drainage located to the west (Ref. 22, pp.26,29,130). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation. Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater (Ref. 223, p.20).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 20, p.36; 22, p.32; 43, pp.2515,2619). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

Because AOC 22 waste piles are spread across two geologies, both BSA-24 and BSA-25 are appropriate BSAs for the AOC. BSA-25 is the most appropriate BSA for waste piles M20A, M20B, and Burial Cell 56, while BSA-24 is the most appropriate BSA for waste piles M22A, M22B, and M22C (Ref. 43, pp. 2518,2521,2622,2625). The BSAs were chosen because of their comparability to their underlying geologies and surface soil types (Refs. 43, pp. 2518,2521,2622,2625). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-24 was used as the background level for waste piles M22A-C while the same was done for BSA-5 and waste

piles M20A, M20B, and Burial Cell 56 (Ref. 200, p.2). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 111, pp.2,57,75,81; 116, pp.2,110,118; 123, pp.2,49; 136, pp.2,55). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 111, pp.2,124,140,146; 116, pp.2,201; 123, pp.2,137).

Table 29. Sample Description and Analytical Results for AOC 22

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 25)								20, p.36; 43, p.2621
B25-SS04-01-060418	0-6”	Silty sand	1806160-23	6/4/18	Uranium (mg/kg)	2.5	0.01	43, p. 6988; 118, pp.6, 66; 220, pp. 190, 191
BSA-25	0-6”	Silty sand	1806159	6/4/18	Radium-226 (pCi/g)	2.65*	NA	43, p.6986; 200, p.2; 118, p.11; 220, p.182
AOC Sample – Mesa IV Mine No. 1 Waste Pile M20A and Burial Cell 56								
M20-SS147-01-091718	0-6”	Sandy silt	1809477-35	9/17/18	Uranium (mg/kg)	370	1	20, p.248; 116, pp.5, 110; 220, pp. 888, 890
M20-SS147-01-091718	0-6”	Sandy silt	1809478-35	9/17/18	Radium-226 (pCi/g)	278 M3	NA	20, p.248; 116, pp. 17, 201; 220, pp. 658, 660
AOC Samples – Mesa IV Mine No. 1 Waste Pile M20B								
M20-SS394-01-091718	0-6”	Silty sand	1809477-39	9/17/18	Uranium (mg/kg)	97	0.99	20, p.252; 116, p.5, 118; 220, pp.888, 890
M20-XS365-02-060618	0-3”	Waste rock sand	1806222-19	6/6/18	Radium-226 (pCi/g)	65.8	NA	111, p.6, 124; 220, pp.221, 222
Background Sample (BSA 24)								43, p. 2515; 22, p.32;
B24-SS26-01-071618	0-6”	Silty sand	1807365-29	7/16/18	Arsenic (mg/kg)	3.5	0.22	43, p. 6982; 117, pp.6, 77;

Table 29. Sample Description and Analytical Results for AOC 22								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
								220, pp.389, 390
B24-SS06-01-071618	0-6”	Silty sand	1807365-9	7/16/18	Uranium (mg/kg)	1.9	0.011	43, p. 6980; 117, pp.6, 37; 220, pp. 389, 390
BSA-24	0-6”	Silty sand	1807366	7/16/18	Radium-226 (pCi/g)	2.06*	NA	43, pp. 6977, 6978; 117, p.10; 200, p.2; 220, p.395
AOC Sample – Mesa IV Mine No. 3 Waste Pile M22A								
M22-XS112-01-091418	0-3”	Waste rock sand	1809475-14	9/14/18	Uranium (mg/kg)	17	0.0097	22, p.180; 123, pp.6, 49; 220, pp.627, 628
M22-XS112-01-091418	0-3”	Waste rock sand	1809476-14	9/14/18	Radium-226 (pCi/g)	12.2	NA	22, p.180; 123, pp. 11,137; 220, pp. 637,638
AOC Samples – Mesa IV Mine No. 3 Waste Pile M22B								
M22-SS60-01-091718	0-6”	Gra-vel	1809418-11	9/17/18	Arsenic (mg/kg)	17	0.18	22, p.188; 136, pp.5, 55; 220, pp.566, 567
M22-XS60-01-060418	0-3”	Waste rock sand	1806235-30	6/4/18	Uranium (mg/kg)	67	0.0098	22, p. 171; 111, pp.6, 81; 220, pp.235, 236
M22-XS60-01-060418	0-3”	Waste rock sand	1806222-30	6/4/18	Radium-226 (pCi/g)	39.3*	NA	22, p. 171; 111, pp. 12,146; 220, pp. 221, 222
AOC Sample – Mesa IV Mine No. 3 Waste Pile M22C								

Table 29. Sample Description and Analytical Results for AOC 22								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
M22-XS14-01-060418	0-3”	Waste rock sand	1806235-27	6/4/18	Arsenic (mg/kg)	16	0.2	22, p.175; 111, pp.6, 75; 220, pp.235, 236
M22-XS14-01-060418	0-3”	Waste rock sand	1806235-27	6/4/18	Uranium (mg/kg)	14	0.0099	22, p.175; 111, pp.6, 75; 220, pp.235, 236
M22-XS14-01-060418	0-3”	Waste rock sand	1806222-27	6/4/18	Radium-226 (pCi/g)	12.9	NA	22, p.175; 111, pp. 12,140; 220, pp. 221, 222

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC.

Number by which this AOC is to be identified: 23

Name of AOC: Mesa IV Mine No. 2 Waste Pile M21A, Waste Pile M21B, Waste Pile M21C, Waste Pile M21D, Waste Pile M21E, Waste Pile M21F, and Burial Cell 63

AOC Type: Pile

Location and description of AOC (with reference to a map of the mine): Figure 9 and Figure 11

AOC 23 comprises seven waste piles: Mesa IV Mine No. 2 Waste Pile M21A, Waste Pile M21B, Waste Pile M21C, Waste Pile M21D, Waste Pile M21E, Waste Pile M21F, and Burial Cell 63 (Ref. 21, p.27). All waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history. Waste Piles M21A and M21B have the greatest volume of waste material remaining in the AOC. Both waste piles have an average approximate depth of 5 feet and are located on slopes greater than 30 degrees. Waste Piles M21A and M21B are highly erodible, and offsite migration has been documented with waste material transported to the Cove Wash Middle 2 drainage. Waste Piles M21C, M21D, and M21E have an average depth of 3 feet and are on a steep slope. These waste piles are also highly erodible, and offsite migration has been documented with waste material transported to the Cove Wash Middle

1G drainage. Waste Pile M21F encompasses Burial Cell 63. Waste Pile M21F has an average depth of 2 feet on a slope greater than 30 degrees (Ref. 21, pp.31,32,134,137). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation. Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater (Ref. 223, p. 20).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 21, p.35; 43, p.2515). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-24 was selected as the most appropriate background location for AOC 23 because it is within the same geologic unit (undifferentiated Summerville and Entrada Formations) and it hosts soil of the same type (Ref. 21, pp. 23,24,34; 43, pp.2495,2498). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 119, pp.2,45; 120, pp.2,72,76; 121, pp.2,50; 122, pp.2,44). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 119, pp.2,96; 120, pp.2,150,154; 121, pp.2,83; 122, pp.2,85).

Table 30. Sample Description and Analytical Results for AOC 23

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 24)								21, p.35; 43, p.2517
B24-SS06-01-071618	0-6”	Silty sand	1807365-9	7/16/18	Uranium (mg/kg)	1.9	0.011	43,p.6980; 117, pp.6, 37; 220, pp.389, 390
BSA-24	0-6”	Silty sand	1807366	7/16/18	Radium-226 (pCi/g)	2.06*	NA	43, pp.6977, 6978; 117, p.10; 200, p.2; 220, p.395
AOC Sample – Mesa IV Mine No. 2 Waste Pile M21A								
M21-SS434-01-091218	0-6”	Waste rock sand	1809283-5	9/12/18	Uranium (mg/kg)	630	0.49	21, p.279; 119, pp.6, 45; 220, pp.896, 897
M21-SS434-	0-6”	Waste rock sand	1809284-5	9/12/18	Radium-226 (pCi/g)	307 M3	NA	21, p.279; 119, pp. 13,96;

Table 30. Sample Description and Analytical Results for AOC 23								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
01-091218								220, pp. 479, 480
AOC Sample – Mesa IV Mine No. 2 Waste Pile M21B								
M21-XS503-01-091218	0-3”	Waste rock sand	1809473-28	9/12/18	Uranium (mg/kg)	66	0.0094	21, p.266; 120, pp.6, 76; 220, pp.611, 312
M21-XS503-01-091218	0-3”	Waste rock sand	1809474-28	9/12/18	Radium-226 (pCi/g)	47.3	NA	21, p.266; 120, pp. 10,154; 220, pp. 619, 620
AOC Sample – Mesa IV Mine No. 2 Waste Pile M21C								
M21-XS323-01-091218	0-6”	Waste rock sand	1809473-26	9/12/18	Uranium (mg/kg)	38	0.0093	21, p.273; 120, pp.6, 72; 220, pp.611, 612
M21-XS323-01-091218	0-6”	Waste rock sand	1809474-26	9/12/18	Radium-226 (pCi/g)	34.3	NA	21, p.273; 120, pp. 10,150; 220, pp. 619, 620
AOC Sample – Mesa IV Mine No. 2 Waste Pile M21D and Waste Pile M21E								
M21-SS280-01-091718	0-6”	Silty Sand	1809424-9	9/17/18	Uranium (mg/kg)	17	0.01	21, p.284; 121, pp.5, 50; 220, pp.576, 577
M21-SS280-01-091718	0-6”	Silty Sand	1809425-9	9/17/18	Radium-226 (pCi/g)	15.4	NA	21, p.284; 121, pp. 12,83; 220, pp. 581, 582
AOC Sample – Mesa IV Mine No. 2 Waste Pile M21F and Burial Cell 63								
M21-XS403-01-060818	0-3”	Waste rock sand	1806234-16	6/8/18	Uranium (mg/kg)	81	0.0097	21, p.267; 122, pp.5, 44; 220, pp.231, 232
M21-XS403-	0-3”	Waste rock sand	1806224-16	6/8/18	Radium-226 (pCi/g)	71.3	NA	21, p.267; 122, pp.9, 85; 220,

Table 30. Sample Description and Analytical Results for AOC 23								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
01-060818								pp.227, 228

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref. 119, p. 96).

Number by which this AOC is to be identified: 24

Name of AOC: Mesa IV, West Mine Waste Pile M23 and Burial Cell 70b

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 10 and Figure 11

AOC 24 comprises two waste piles: Mesa IV, West Mine Waste Pile M23 and Burial Cell 70b. Both waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history. Waste Pile M23 lies below a 20-foot cliff in the western portion of the mine area and has a depth of approximately 5 feet on a slope greater than 30 degrees. A drainage transects Waste Pile M23 and connects to the Cove Wash Middle 1 drainage downgradient of the mine. Burial Cell 70b is located upgradient of Waste Pile M23 (Ref. 23, pp.26,30). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation (Ref. 23, pp.22,23). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater (Ref. 223, p. 20).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 23, p.33; 43, p.2722). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-26 was selected as the most appropriate background location for AOC 24 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it's the closest BSA to the AOC (Refs. 23, pp. 22,23,32; 43, pp. 2702,2705). The metals analysis was performed by ALS Environmental Laboratories using

USEPA method SW-846 6020A ICP-MS (Ref. 124, pp.2,25). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 124, pp.2,38).

Table 31. Sample Description and Analytical Results for AOC 24

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 26)								23, p.33; 43, p.2724
B26-SS27-01-060518	0-6”	Clayey sand	1806162-16	6/5/18	Uranium (mg/kg)	16	0.011	43, p.6998; 125, pp.6, 53; 220, pp.206, 207
BSA-26	0-6”	Silty sand	1806161	6/5/18	Radium-226 (pCi/g)	11.02*	NA	43, pp. 6993, 6994; 200, p.2; 125, p.11; 220, p.198
AOC Sample – Mesa IV, West Mine Waste Pile M23 and Burial Cell 70b								
M23-XS54-01-061118	0-3”	Waste rock sand	1806312-1	6/11/18	Uranium (mg/kg)	86	0.01	23, p.183; 124, pp.5, 25; 220, pp.251, 252
M23-XS54-01-061118	0-3”	Waste rock sand	1806311-1	6/11/18	Radium-226 (pCi/g)	76.2 M3	NA	23, p.183; 124, pp.9, 38; 220, pp.247, 248

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref. 124, p. 38).

Number by which this AOC is to be identified: 25

Name of AOC: Mesa IV 1/4 Mine Waste Pile CO-10_NNWP01

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 10 and Figure 11

AOC 25 comprises one waste pile: Mesa IV 1/4 Mine Waste Pile CO-10_NNWP01. This waste pile is in the southeast portion of the mine area with scattered waste rock extending downslope to the east into the inaccessible area of the mine. The mine area is located on 20- to 35-degree slopes (Ref. 82, p7). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation. Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater (Ref. 223, p.20).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 79, p.5; 63, p.65). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

The Morrison Formation BRA was chosen by Cyprus Amax to best represent the background levels for AOC 20 (Refs. 63, p.63; 82, p.8). The highest concentration of each metal analyte from all samples collected from the Morrison Formation BRA was chosen as the background level (Ref. 63, p.63). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 164, p.1990). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 164, p.2125).

Table 32. Sample Description and Analytical Results for AOC 25

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Background – Morrison Formation)								79, p.5; 63, p.65
SS-CO-B1-008-10142017	0-6”	Unavailable	1710392-9	10/14/17	Arsenic (mg/kg)	2.2	0.2	169, p.5,1387
SS-CO-B1-021-10142017	0-6”	Unavailable	1710392-23	10/14/17	Uranium (mg/kg)	1.5	0.01	169, p.1401
Morrison Ra-226	0-6”	Unavailable	1710392	10/14/17	Radium-226 (pCi/g)	1.39*	NA	200, p.2;
AOC Samples – Mesa IV 1/4 Mine Waste Pile CO-10_NNWP01								
SS-10-NWP01-002-10162	0-6”	Waste rock sand	1810422-21	10/16/18	Arsenic (mg/kg)	7.1	0.21	164, pp.13, 1990

Table 32. Sample Description and Analytical Results for AOC 25								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
SS-10-NWP01-002-10162	0-6”	Waste rock sand	1810422-21	10/16/18	Uranium (mg/kg)	25	0.011	164, p. 1990
SS-10-NWP01-003-10162	0-6”	Waste rock sand	1810422-5	10/16/18	Radium-226 (pCi/g)	59.6 M3	NA	164, p. 2125

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC (Ref. 164, p. 2125).

Number by which this AOC is to be identified: 26

Name of AOC: Mesa IV 1/2 Mine and Simpson 181 Waste Pile M19, Burial Cell 86a, and Burial Cell 86b; Mesa V Mine – 508 Waste Pile M18 and Burial Cell 87a; North Portal Frank No. 1 Mine Waste Pile CO-05_NNWP01, Waste Pile CO-05_NNWP02, Waste Pile CO-05_NNWP03, and Waste Pile CO-05_NNWP04; East Portal Frank No. 1 Mine Waste Pile CO-05_NNWP05, Waste Pile CO-05_NNWP06, Waste Pile CO-05_NNWP07, Waste Pile CO-05_NNWP08, Waste Pile CO-05_NNWP09, Waste Pile CO-05_NNWP10, Waste Pile CO-05_NNWP11, Waste Pile CO-05_NNWP12, and Waste Pile CO-05_NNWP13; South Portal Frank No. 1 Mine Waste Pile CO-05_NNWP14, Waste Pile CO-05_NNWP15, Waste Pile CO-05_NNWP16, Waste Pile CO-05_NNWP17, Waste Pile CO-05_NNWP18, and Waste Pile CO-05_NNWP19; and Frank No. 2 Mine Waste Pile CO-06_NNWP01.

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 10 and Figure 11

AOC 26 comprises 25 waste piles: Mesa IV 1/2 Mine and Simpson 181 Waste Pile M19, Burial Cell 86a, and Burial Cell 86b; Mesa V Mine – 508 Waste Pile M18 and Burial Cell 87a; North Portal Frank No. 1 Mine Waste Pile CO-05_NNWP01, Waste Pile CO-05_NNWP02, Waste Pile CO-05_NNWP03, and Waste Pile CO-05_NNWP04; East Portal Frank No. 1 Mine Waste Pile CO-05_NNWP05, Waste Pile CO-05_NNWP06, Waste Pile CO-05_NNWP07, Waste Pile CO-05_NNWP08, Waste Pile CO-05_NNWP09, Waste Pile CO-05_NNWP10, Waste Pile CO-05_NNWP11, Waste Pile CO-05_NNWP12, and Waste Pile CO-05_NNWP13; South Portal Frank No. 1 Mine Waste Pile CO-05_NNWP14, Waste Pile CO-05_NNWP15, Waste Pile CO-05_NNWP16, Waste Pile CO-05_NNWP17, Waste Pile CO-05_NNWP18, and Waste Pile CO-05_NNWP19; and Frank No. 2 Mine Waste Pile CO-06_NNWP01 (Refs. 18, pp.27,30, 31; 19, pp.32,33; 76, pp.6,7,8,41,42,43, 95, 96, 97, 98; 77, pp.4,32).

Cyprus Amax prepared the RSE report for the waste piles in AOC 26 under a consent decree signed in 2017 (Ref. 199, p. 95). The Cyprus Amax RSE breaks out waste piles into smaller areas than other RSEs, and, thus, this AOC contains 25 small areas considered to be interconnected waste piles. All waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, and similar past operational history.

Mesa IV 1/2 Mine and Simpson 181 is located south of Mesa V Mine – 508. South of Mesa IV 1/2 Mine and Simpson 181 is the North Portal Frank No. 1 Mine (Ref. 18, p.21). East Portal Frank No. 1 Mine and South Portal Frank No. 1 Mine are located southeast and south of North Portal Frank No.1 Mine, respectively (Refs.19, p.22; 76, pp.41,42,43). Frank No. 2 Mine is located between East Portal Frank No. 1 Mine and South Portal Frank No. 1 Mine (Ref.76, p.42). All are located along the same ore outcrop on the south side of Mesa V.

Mine waste at Mesa IV 1/2 Mine and Simpson 181 Waste Pile M19 is shallow at approximately 3 feet deep on a slope greater than 30 degrees in places and is highly erodible. Burial Cell 86b is located northwest of Waste Pile M19 and vegetated. A tributary of the Cove Wash Middle 1B runs along the southern boundary of Burial Cell 86b and bisects Waste Pile M19 (Ref. 19, pp.32,33,133). Mesa V Mine – 508 Waste Pile M18 is a surficial waste pile at approximately 4 feet deep on a slope greater than 30 degrees and is highly erodible. A drainage runs directly through the waste pile boundary and likely flows down to the Cove Wash Middle 1B drainage. Burial Cell 87a is located north and upgradient of Waste Pile M18 (Ref. 18, pp.-30,-31). The waste generated at the mines is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation (Refs. 18, pp.23,24; 19, pp.24,25). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The workings at Mesa V Mine – 508 extend north, east, and west of the mine area and connect to Mesa V Mine – 103 (Ref. 18, p.27).

North Portal Frank No. 1 Mine Waste Pile CO-05_NNWP01 is buried, but a clean cover as defined by CERCLA appears not to have been applied; therefore, the waste pile does not have a continuous cover of 2 feet or greater (Ref. 76, p.10). Waste Pile CO-05_NNWP02 is in the northeast portion of North Portal Frank No. 1 Mine and extends downslope into a wash and steep inaccessible areas of the mine (Ref. 76, p.10). The Cove Wash Middle 1B drainage runs along the northern portion of North Portal Frank No. 1 Mine and connects with a tributary to the Cove Wash Middle 1B drainage that runs across Mesa IV 1/2 Mine and Simpson 181 (Refs. 19, p.33; 76, pp.10,49). Waste Piles CO-05_NNWP03 and CO-05_NNWP04 are noted as reclaimed waste rock piles, but surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater.

East Portal Frank No. 1 Mine Waste Piles CO-05_NNWP05 through CO-05_NNWP10 are in inaccessible areas of the mine site. These five waste piles are below the main bench of the mine. Waste Piles CO-05_NNWP11, CO-05_NNWP12, and CO-05_NNWP13 are located along the west end of the main bench (Ref. 76, pp.10,11,50). A drainage cuts across the mine area and connects to the Cove Wash Middle 1C drainage (Ref. 63, p.85). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater.

South Portal Frank No. 1 Mine Waste Piles CO-05_NNWP15, CO-05_NNWP16, and CO-05_NNWP18 are located below the main bench in the southern portion of the mine area below a steep cliff edge. Waste Piles CO-05_NNWP14, CO-05_NNWP17, and CO-05_NNWP19 were moved and buried, but surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater (Ref. 76, pp.11,43). A drainage runs across the mine area and connects to the Cove Wash Middle 1D drainage (Ref. 23, p.20).

Frank No. 2 Mine Waste Pile CO-06_NNWP01 is partially accessible with material spilled over a steep cliff. Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a

continuous cover of 2 feet or greater. Frank No. 2 Mine and East Portal Frank No. 1 Mine straddle the same Cove Wash Middle 1C drainage (Ref. 63, p.85).

The waste generated at Mesa IV 1/2 Mine and Simpson 181, Mesa V Mine – 508, North Portal Frank No. 1 Mine, East Portal Frank No. 1 Mine, South Portal Frank No. 1 Mine, and Frank No. 2 Mine is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation (Refs. 18, p.24; 19, p.25; 76, pp.41,42,43; 77, p.22).

All waste samples are surface samples collected from the waste piles but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 18, p.33; 19, p.35; 43, pp.2001,2104; 63, p.65; 76, p.10; 80, p.5). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-19 was selected as the most appropriate background location for waste piles M19 and Burial Cell 86b (Ref. 19, p.35; 43, p.2001). BSA-20 was selected as the most appropriate background location for waste piles M18 and Burial Cell 87a (Ref. 18, p.33; 43, p.2104). The Morrison Formation BSA was the most appropriate BRA for the remaining waste piles (Ref. 63, p.65; 76, p.10; 80, pp. 5). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 84, pp 2,71,73; 113, pp.59,61; 115, pp.2,25,27; 149, pp.472,1164,2143,2321,2749,2754, 2759, 2762, 2769, 3020, 4325; 162, p.77; 169, pp.1120,1387,1401). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 84, pp. 2,128; 113, p.108; 115, pp.2,51; 149, pp.761,1520,2256,2453,2662, 2894,2896,2901,2904,2912,3658,4473,4494; 162, p.347; 169, p.1604).

Table 33. Sample Description and Analytical Results for AOC 26

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 19)								19, p.35; 43, p.2001
B19-SS28-01-052618	0-6”	Silty sand	1806158-15	5/26/18	Uranium (mg/kg)	1	0.01	43, p.6938; 112, pp. 6, 50; 220, p.174
BSA-19	0-6”	Silty sand	1806157	5/26/18	Radium-226 (pCi/g)	1.43*	NA	43, p.6932; 200, p.2; 112, p.10; 220, p.166
AOC Sample – Mesa IV 1/2 Mine and Simpson 181 Waste Pile M19								
M19-SS36-01-091818	0-6”	Waste	1809426-18	9/18/18	Uranium (mg/kg)	390	0.1	19, p.188; 84, pp.6,73; 220, p.586

Table 33. Sample Description and Analytical Results for AOC 26								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
M19-SS36-01-091818	0-6”	Waste	1809427-18	9/18/18	Radium-226 (pCi/g)	157 M3	NA	19, p.188; 84, pp.10,128; 220, p.592
AOC Sample – Mesa IV 1/2 Mine and Simpson 181 Burial Cell 86b								
M19-XS22-02-052318	0-3”	Waste	1805632-7	5/23/18	Uranium (mg/kg)	370	0.1	19, p.178; 115, pp.5,25; 220, p.158
M19-XS22-02-052318	0-3”	Waste	1805633-8	5/23/18	Radium-226 (pCi/g)	21.5 (215 J)	NA	19, p.178; 115, pp.9,51; 220, p.162
Background Sample (BSA 20)								18, p.33; 43, p.2104
B20-SS25-01-052318	0-3”	Sandy loam	1805628-30	5/23/18	Arsenic (mg/kg)	1.6	0.2	43, p. 6945; 114, pp.6, 79; 220, p.139
B20-SS12-01-052318	0-3”	Sandy loam	1805628-15	5/23/18	Uranium (mg/kg)	0.55	0.01	43, p. 6943; 114, pp.6, 49; 220, p.138
BSA-20	0-6”	Sandy loam	1805629	5/23/18	Radium-226 (pCi/g)	0.81*	NA	43, pp. 6940, 6941; 200, p.2; 114, p.10; 220, p.141
AOC Sample – Mesa V Mine – 508 Waste Pile M18 and Burial Cell 87a								
M18-SS115-01-091418	0-6”	Sand with silt and gravel	1809349-12	9/14/18	Arsenic (mg/kg)	26	0.2	18, p.217; 113, pp.5,59; 220, p.903
M18-SS115-02-091418	0-6”	Sand with silt and gravel	1809349-13	9/14/18	Uranium (mg/kg)	22	0.0098	18, p.217; 113, pp.5,61; 220, p. 901
M18-S115-02-091418	0-6”	SM with gravel	1809351-13	9/14/18	Radium-226 (pCi/g)	15.9	NA	18, p.217; 113, p.9,108; 220, p.507

Table 33. Sample Description and Analytical Results for AOC 26								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
Background Sample (Background – Morrison Formation)								76, p.10; 63, p.65
SS-CO-B1-021-10142017	0-6”	Unavailable	1710392-23	10/14/17	Uranium (mg/kg)	1.5	0.01	169, p. 14,1401
Morrison Ra-226	0-6”	Unavailable	1710392	10/14/17	Radium-226 (pCi/g)	1.39*	NA	200, p.2; 169, p.14
AOC Sample – North Portal Frank No. 1 Mine Waste Piles CO-05_NNWP01 and CO-05_NNWP04								
SB-05-NNWP01-002-1.0-1.	12-18”	Waste	1810425-19	10/12/18	Radium-226 (pCi/g)	5.82	NA	149, pp.13,4494
AOC Sample – North Portal Frank No. 1 Mine Waste Pile CO-05_NNWP02								
SS-05-NNWP02-001-10062	0-6”	Waste	1810357-13	10/6/18	Uranium (mg/kg)	95	0.0099	149, pp. 13, 3020
SS-05-NNWP02-001-10062	0-6”	Waste	1810357-13	10/6/18	Radium-226 (pCi/g)	56 M3	NA	149, pp.13,3658
AOC Sample – North Portal Frank No. 1 Mine Waste Pile CO-05_NNWP03								
SB-05-NNWP03-002-1.0-1.	12-18”	Waste	1810425-13	10/12/18	Uranium (mg/kg)	43	0.011	149, pp.13,4325
SB-05-NNWP03-002-1.0-1.	12-18”	Waste	1810425-13DUP	10/12/18	Radium-226 (pCi/g)	13.4	NA	149, pp.13,4473
AOC Sample – East Portal Frank No. 1 Mine Waste Pile CO-05_NNWP05								
SB-05-NNWP05-001-1.0-1.	12-18”	Waste	1809446-15	9/17/18	Uranium (mg/kg)	16	0.01	149, pp.13,2762
SB-05-NNWP05-001-1.0-1.	12-18”	Waste	1809446-15	9/17/18	Radium-226 (pCi/g)	12.5	NA	149, pp.13,2904

Table 33. Sample Description and Analytical Results for AOC 26								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
AOC Sample – East Portal Frank No. 1 Mine Waste Piles CO-05_NNWP06, CO-05_NNWP08, CO-05_NNWP09, and CO-05_NNWP10								
SB-05-NNWP06-001-1.0-1.	12-18”	Waste	1809446-2	9/17/18	Uranium (mg/kg)	14	0.01	149, pp.13,2749
SB-05-NNWP06-002-1.0-1.	12-18”	Waste	1809446-5	9/17/18	Radium-226 (pCi/g)	10.1	NA	149, pp.13,2894
AOC Sample – East Portal Frank No. 1 Mine Waste Piles CO-05_NNWP11 and CO-05_NNWP07								
SB-05-NNWP11-001-1.0-1.	12-18”	Waste	1809446-12	9/17/18	Uranium (mg/kg)	15	0.01	149, pp.13,2759
SB-05-NNWP11-001-1.0-1.	12-18”	Waste	1809446-12	9/17/18	Radium-226 (pCi/g)	10.1	NA	149, pp.13,2901
AOC Sample – East Portal Frank No. 1 Mine Waste Pile CO-05_NNWP12								
SS-05-NNWP12-001-09172	0-6”	Waste	1809446-22	9/17/18	Uranium (mg/kg)	14	0.0087	149, pp.13,2769
SS-05-NNWP12-001-09172	0-6”	Waste	1809446-22	9/17/18	Radium-226 (pCi/g)	12.3	NA	149, pp.13,2912
AOC Sample – East Portal Frank No. 1 Mine Waste Pile CO-05_NNWP13								
SS-05-NNWP13-001-09172	0-6”	Waste	1809446-7	9/17/18	Uranium (mg/kg)	9,3	0.0099	149, pp. 13, 2754
SS-05-NNWP13-001-09172	0-6”	Waste	1809446-7	9/17/18	Radium-226 (pCi/g)	7.5	NA	149, pp.13,2896
AOC Sample – South Portal Frank No. 1 Mine Waste Pile CO-05_NNWP14								
SB-05-NNWP14-001-1.0-1.	12-18”	Waste	1809343-17	9/14/18	Radium-226 (pCi/g)	5.68	NA	149, pp. 13, 2662
AOC Sample – South Portal Frank No. 1 Mine Waste Pile CO-05_NNWP15								

Table 33. Sample Description and Analytical Results for AOC 26								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
SS-05-MS-004-10242017	0-6”	Waste	1710606-5	10/24/17	Uranium (mg/kg)	120	0.095	149, pp. 13, 472
SS-05-MS-004-10242017	0-6”	Waste	1710606-5	10/24/17	Radium-226 (pCi/g)	91	NA	149, pp. 13, 761
AOC Sample – South Portal Frank No. 1 Mine Waste Pile CO-05_NNWP16								
SB-05-NNWP16-001-1.0-1.	12-18”	Waste	1809339-2	9/11/18	Uranium (mg/kg)	470	0.099	149, pp. 13, 1164
SB-05-NNWP16-001-1.0-1.	12-18”	Waste	1809339-2	9/11/18	Radium-226 (pCi/g)	176	NA	149, pp. 13, 1520
AOC Sample – South Portal Frank No. 1 Mine Waste Pile CO-05_NNWP18								
SB-05-NNWP18-003-1.0-1.	12-18”	Waste	1809342-8	9/13/18	Uranium (mg/kg)	630	0.091	149, pp. 13, 2321
SS-05-NNWP18-03-091320	0-6”	Waste	1809342-7	9/13/18	Radium-226 (pCi/g)	125	NA	149, pp.13,2453
AOC Sample – South Portal Frank No. 1 Mine Waste Piles CO-05_NNWP19 and CO-05_NNWP17								
SB-05-NNWP19-002-1.0-1.	12-18”	Waste	1809340-14	9/12/18	Uranium (mg/kg)	31	0.0099	149, pp. 13, 2143
SB-05-NNWP19-002-1.0-1.	12-18”	Waste	1809340-14	9/12/18	Radium-226 (pCi/g)	10.3	NA	149, pp. 13, 2256
Background Sample (Background –Morrison Formation)								80, p.5; 63, p.65
SS-CO-B1-021-10142017	0-6”	Unavailable	1710392-23	10/14/17	Uranium (mg/kg)	1.5	0.01	169, pp. 13, 1401
Morrison Ra-226	0-6”	Unavailable	1710392	10/14/17	Radium-226 (pCi/g)	1.39*	NA	200, p.2; 169, p.13
AOC Sample – Frank No. 2 Mine Waste Pile CO-06_NNWP01								

Table 33. Sample Description and Analytical Results for AOC 26								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
SS-06-MS-003-10252017	0-6”	Waste	1710590-3	10/24/17	Uranium (mg/kg)	360	0.1	162, pp. 14, 77
SS-06-MS-003-10252017	0-6”	Waste	1710590-3DUP	10/24/17	Radium-226 (pCi/g)	305 M3	NA	162, pp.12,347

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

E This flag identifies compounds whose concentration exceeds the upper level of the calibration range.

J The analyte was detected at the reported concentration; the quantitation is an estimate. As a waste sample, the concentration of this qualified data is reported with an adjustment (Ref. 48, p.7, 8).

LT Result is less than the requested minimum detectable concentration (MDC) but greater than the sample-specific MDC.

M3 The requested MDC was not met, but the reported activity is greater than the reported MDC.

Number by which this AOC is to be identified: 27

Name of AOC: NA-0316 Waste Pile CO-11_NNWP01, Waste Pile CO-11_NNWP02, and Waste Pile CO-11_NNWP03

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 10 and Figure 11

AOC 27 comprises three waste piles: NA-0316 Waste Pile CO-11_NNWP01, Waste Pile CO-11_NNWP02, and Waste Pile CO-11-NNWP03. These three mine features are aggregated together into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history. Waste Pile CO-11_NNWP01 and Waste Pile CO-11_NNWP02 are located along the central and south edge of the main bench, respectively, and consist of scattered waste below the cliff edge and main bench. According to NAML, Waste Pile CO-11_NNWP03 is in the northwestern portion of the mine area above Waste Piles CO-11_NNWP01 and CO-11_NNWP02 (Ref. 78, pp.4,24). A drainage runs across the mine area and connects to the Cove Wash Middle 1E drainage (Ref. 23, p.20). The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation. Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report

as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background reference area (Refs. 78, p.6; 63, p.65). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

The Morrison Formation BRA was chosen by Cyprus Amax to best represent the background levels for AOC 20 (Refs. 63, p.63; 82, p.8). The highest concentration of each metal analyte from all samples collected from the Morrison Formation BRA was chosen as the background level (Ref. 63, p.63). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 163, pp.708,940,948). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 163, pp.845,1089,1098).

Table 34. Sample Description and Analytical Results for AOC 27

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Background – Morrison Formation)								78, p.6; 63, p.65
SS-CO-B1-021-10142017	0-6”	Unavailable	1710392-23	10/14/17	Uranium (mg/kg)	1.5	0.01	169, pp. 13,1401
Morrison Ra-226	0-6”	Unavailable	1710392	10/14/17	Radium-226 (pCi/g)	1.388*	NA	200, p. 2; 169, p.13
AOC Sample – NA-0316 Waste Pile CO-11_NNWP01								
SS-11-NNWP01-001-10132	0-6”	Waste	1810419-17	10/13/18	Uranium (mg/kg)	9.9	0.011	163, pp. 13, 948
SS-11-NNWP01-001-10132	0-6”	Waste	1810419-17	10/13/18	Radium-226 (pCi/g)	7.7	NA	163, pp. 13, 1098
AOC Sample – NA-0316 Waste Pile CO-11_NNWP02								
SS-11-NNWP02-004-10132	0-6”	Waste	1810419-9	10/13/18	Uranium (mg/kg)	150	0.11	163, pp. 13, 940
SS-11-NNWP02-004-10132	0-6”	Waste	1810419-9	10/13/18	Radium-226 (pCi/g)	72	NA	163, pp. 13, 1089
AOC Sample – NA-0316 Waste Pile CO-11_NNWP03								
SS-11-NNWP0	0-6”	Waste	1809441-12	9/17/18	Uranium (mg/kg)	7.5	0.0093	163, pp. 13, 708

Table 34. Sample Description and Analytical Results for AOC 27								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
3-003-09172								
SS-11-NNWP03-001-09172	0-6”	Waste	1809441-6	9/17/18	Radium-226 (pCi/g)	8.2	NA	163, pp.13,845

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 28

Name of AOC: Cov087 Waste Pile

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 10 and Figure 11

AOC 28 comprises one waste pile: Cov087 Waste Pile. The waste generated is a result of mine operations in ore bodies in the Salt Wash Member of the Lower Morrison Formation. Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater (Ref. 53, p.11).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 78, p.6; 63, p.65).

BSA-20 was selected as the most appropriate background location for AOC 28 because it is within the same geologic unit (Morrison Formation) and it hosts soil of the same type (Refs. 18, p. 25; 76, p. 49; 43, pp. 2084,2087). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 163, pp.708,940,948). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 163, pp.845,1089,1098).

Table 35. Sample Description and Analytical Results for AOC 28								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
Background Sample (BSA 20)								18, p.33; 43, p.2104
B20-SS25-01-052318	0-3”	Sandy loam	1805628-30	5/23/18	Arsenic (mg/kg)	1.6	0.2	43, p.6945; 114, pp.6,79; 220, p. 139
B20-SS25-01-052318	0-3”	Sandy loam	1805628-30	5/23/18	Lead (mg/kg)	5.4	0.2	43, p.6945; 114, pp.6,79; 220, p. 139
B20-SS25-01-052318	0-3”	Sandy loam	1805628-30	5/23/18	Uranium (mg/kg)	0.29	0.01	43, p.6945; 114, pp.6,79; 220, p. 139
AOC Sample – Cov087 Waste Pile								
M18-XS161-01-052518	0-3”	Silty sand with gravel	1805632-6	5/25/18	Arsenic (mg/kg)	5.6	0.2	115, pp.23,47; 220, p. 160
M18-XS161-01-052518	0-3”	Silty sand with gravel	1805632-6	5/25/18	Lead (mg/kg)	21	0.2	115, pp.23, 47; 220, p. 160
M18-XS161-01-052518	0-3”	Silty sand with gravel	1805632-6	5/25/18	Uranium (mg/kg)	300	0.098	115, pp.23; 220, p. 160

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

Description of Areas of Concern – Mesa IV

Given the interconnected nature of the ore bodies, similar mining processes, similar time frames of operation, and general geology of the LMMD site, the possible mining-related sources listed below may be releasing hazardous substances to the Cove Wash drainages or exposing human or terrestrial sensitive environment targets.

The other possible sources and AOCs will be evaluated during further investigation of this area.

Table 36. Mesa IV Other Area of Concern	
Other Area of Concern	**Description (Reference)**
Cov068	Cov068 is northwest of Mesa IV, Mine No. 3. The mine-related area is within the Lower Morrison Formation (Ref. 22, p.23). Inventory of Cov068 lists two waste piles, one rimstrip, and one pit. The two waste piles were documented in the southern portion of the mine area and are approximately 80 feet apart (Ref. 47, pp.4,10,11). Weston conducted a gamma scan in 2010, and the highest gamma measurement was 353,622 cpm, which is significantly higher than the highest background gamma level measurement of 9,805 cpm (Ref. 47, pp.3,10,11).

Areas of Observed Contamination 29 to 32 – Mesa V and Mesa VI

The Mesa V and Mesa VI area includes four AOCs located at seven mines and mine-related areas.

Table 37. Mesa V and Mesa VI AOCs			
AOC No.	**AOC Type**	**Mine Claim Names**	**RSE Waste Pile Names**
29	Pile	Mesa V Mine – 103; Mesa V Adit; NA-0344B; Mesa V Incline	Waste Piles M15A, M15B, M16A, M16B, and M17; Burial Cells 91, 92, 93, and 344B-2
30	Pile	Mesa V & Mesa VI	Waste Piles M13A and M13B
31	Pile	Mesa V & Mesa VI	CO-04_NNWP01
32	Pile	Mesa V & Mesa VI	Waste Pile M14

The Mesa V and Mesa VI area includes six mines developed and operated in the 1950s and 1960s by F.A. Sitton, the Navajo Uranium Mining Company, Kerr-McGee (a predecessor of Tronox), and VCA. In addition, one mine was developed in the 1950s and 1960s by the Climax Uranium Company (a predecessor of Cyprus Amax) (Refs. 13, p.26; 14, p.25; 15, p.25; 16, p.26; 17, p.25; 75, p.3). Four additional mine-related areas are also found within the Mesa V and Mesa VI area (Refs. 13, p.26; 14, p.25; 15, p.25; 16, p.26,31; 17, p.25,31). Operations included underground mining that tapped paleochannels in the Salt Wash Member of the Lower Morrison Formation that are rich in uranium and vanadium. Underground mine workings exist throughout the Mesa V and Mesa VI area. Waste piles consist of overburden or lower grade protore discarded near or downslope of portals (Refs. 13, pp.24,27,31; 14, pp.21,31,32; 15, pp.21,30,31; 16, pp.22,32; 17, pp.21,32; 75, pp.23,26).

Number by which this AOC is to be identified: 29

Name of AOC: Mesa V Incline Waste Pile M15A and Waste Pile M15B; Mesa V Adit Waste Pile M 16A, Waste Pile M16B, Burial Cell 91, Burial Cell 92, and Burial Cell 93; Mesa V Mine – 103 Waste Pile M17; NA-0344B Burial Cell 344B-2

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 12

AOC 29 comprises nine waste piles: Mesa V Incline Waste Pile M15A and Waste Pile M15B; Mesa V Adit Waste Pile M16A, Waste Pile M16B, Burial Cell 91, Burial Cell 92, and Burial Cell 93; Mesa V Mine – 103 Waste Pile M17; and NA-0344B Burial Cell 344B-2. These nine mine features are aggregated together into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history. Waste Pile M15A and Waste Pile M15B are located in the northern portion and southern portion of Mesa V Incline, respectively. Offsite migration of waste material from Mesa V Incline into the Cove Wash Middle 1A drainage was confirmed; however, the amount of material is unknown. A drainage was mapped on Waste Pile M15A (Ref. 15, pp.30,31). Waste Pile M16A is located below a cliff in the southern portion of Mesa V Adit. Waste Pile M16A has extreme slopes, exposed ore, and large boulders, and waste from the pile slumps against the cliff wall to the north. Waste Pile M16B is in the northern portion of Mesa V Adit above the cliff area. Two drainages run directly through Waste Pile M16B into the Cove Wash Middle 1A drainage. Waste Pile M16B has an approximate depth of 5 feet and is highly erodible with offsite migration documented (Ref. 16, pp.31,32). Waste Pile M17 is 20 feet deep on a slope greater than 30 degrees and is considered highly erodible. Offsite migration of Waste Pile M17 into the Cove Wash Middle 1A drainage has been documented (Ref. 17, pp.31,32). Within Waste Pile M16B, Burial Cell 91 is located in the northwestern portion, Burial Cell 92 is located in the north-central portion, and Burial Cell 93 is located in the northeastern portion. All three burial cells are covered with material containing elevated radionuclide concentrations. No drainages were mapped within the burial cells, and the material appeared to be stable. Offsite migration of contaminated material from the burial cells is likely (Ref. 16, pp.31,133). Burial Cell 344B-2 is located north of Mesa V Incline. While no mining activities occurred at NA-0344B, Burial Cell 344B-2 was constructed between 2003 and 2004 to include overburden, mine debris, and waste rock from mining that occurred at Mesa V Incline, Mesa V Adit, Mesa V Mine – 103, and Mesa V Mine – 508. The burial cell was covered with 1.5 feet of soil. Because of the relatively flat topography at NA-0344B, the potential for offsite migration is not likely; however, offsite migration would flow through Mesa V Incline and Mesa V Adit before reaching the Cove Wash Middle 1A drainage (Ref. 42, pp.26,29,31,129). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Refs. 15, p.23; 16, p.24; 17, p.23). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater. The workings for Mesa V Mine – 103 extend west to Mesa V Mine – 508 (Ref. 17, p.27).

All waste samples are surface samples collected from the waste piles but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 15, p.33; 16, p.34; 17, p.34; 42, p.33; 43, pp.2001,2207,2309). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-21 was selected as the most appropriate background location for seven of the nine waste piles (M15A, M15B, M16A, M16B, Burial Cell 91, Burial Cell 92, and Burial Cell 93) because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the waste piles (Refs. 15, pp. 22,24,26; 43, p. 2187,2189). BSA-19 was selected as the most appropriate background location for waste piles M17 because it is within the same geologic unit (undifferentiated Summerville and Entrada Formations), it hosts soil of the same type, and it's the closest BSA to the M17 waste pile (Refs. 17, pp. 20,22,33; 43, p. 1981). BSA-22 was selected as the most appropriate background location for waste piles Burial Cell 344B-2 because it is within the same geologic unit (Morrison Formation) and it hosts soil of the same type (Refs. 17, pp. 20,22,33; 43, pp. 2289,2291). The metals analysis was performed by ALS Environmental Laboratories using USEPA method

SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 108, pp.2,35,57,63,71,79; 109, pp.2,92; 110, pp.2,51,94; 111, pp.2,35,37,94,102).

Table 38. Sample Description and Analytical Results for AOC 29

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Samples (BSA 21)								15, p.33; 16, p.34; 43, p.2207
B21-SS07-01-062118	0-6”	Silty sand	1806627-11	6/21/18	Uranium (mg/kg)	9.5	0.0096	43, pp. 6948,6949; 106, p.41; 220, p.277
BSA-21	0-6”	Silty sand	1806626	6/21/18	Radium-226 (pCi/g)	5.46*	NA	43, pp. 6948, 6949; 200, pp. 1, 2; 106, p. 11; 220, p.267
AOC Sample – Mesa V Incline Waste Pile M15A								
M15-XS22-01-052118	0-3”	Waste rock sand	1805592-1	5/21/18	Radium-226 (pCi/g)	63.5 M3	NA	15, p.183; 108, pp. 10, 63; 220, p. 121
AOC Sample – Mesa V Incline Waste Pile M15B								
M15-XS73-01-052118	0-3”	Waste rock sand	1805592-5	5/21/18	Radium-226 (pCi/g)	44.8 M3	NA	15, p.176; 108, pp.10,71; 220, p.119
AOC Samples – Mesa V Adit Waste Pile M16A and Burial Cell 91								
M16-SS193-01-091318	0-6”	Waste rock sand	1809298-3	9/13/18	Uranium (mg/kg)	52	0.0095	16, p. 217; 109, pp. 6, 92; 220, p. 908
M16-XS191-01-052618	0-3”	Waste rock sand	1806222-4	5/26/18	Radium-226 (pCi/g)	39.7	NA	16, p.207; 111, pp.12, 94; 220, p.221
AOC Samples – Mesa V Adit Waste Pile M16B								
M16-XS128-01-052118	0-3”	Waste rock sand	1805589-8	5/21/18	Uranium (mg/kg)	130	0.1	16, p.189; 108, pp. 5, 35; 220, p. 107
M16-XS166-	0-3”	Waste rock sand	1805592-9	5/21/18	Radium-226 (pCi/g)	65.3	NA	16, p.188; 108, pp.10,

Table 38. Sample Description and Analytical Results for AOC 29								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
01-052118								79; 220, p.119
AOC Sample – Mesa V Adit Burial Cell 92 and Burial Cell 93								
M16-SS47-01-091418	0-6”	Sandy gravel	1809365-9	9/14/18	Uranium (mg/kg)	62	0.0096	16, p.221; 110, pp.5, 51; 220, p. 913
M16-SS47-01-091418	0-6”	Waste rock sand	1809366-9	9/14/18	Radium-226 (pCi/g)	76.7 M3	NA	16, p.221; 110, pp.13, 94; 220, p.551
Background Samples (BSA 19)								17, p.34; 43, p.2001
B19-SS18-01-052618	0-6”	Sandy loam	1806158-5	5/26/18	Arsenic (mg/kg)	2.4	0.2	43, p.6932; 112, pp.6, 30; 220, p. 177
B19-SS28-01-052618	0-6”	Sandy loam	1806158-15	5/26/18	Uranium (mg/kg)	1	0.01	43, p.6932; 112, pp.6, 50; 220, p.174
BSA-19	0-6”	Sandy loam	1806157	5/26/18	Radium-226 (pCi/g)	1.43*	NA	43, p.6932; 200, p.1; 112, p.11; 220, p.166
AOC Samples – Mesa V Mine – 103 Waste Pile M17								
M17-XS83-01-052618	0-3”	Waste rock sand	1806235-7	5/26/18	Arsenic (mg/kg)	10	0.2	17, p.194; 111, pp.6, 35; 220, p. 238
M17-XS83-02-052618	0-3”	Waste rock sand	1806235-8	5/26/18	Uranium (mg/kg)	310	0.098	17, p.194; 111, pp.6, 37; 220, p.235
M17-XS83-02-052618	0-3”	Waste rock sand	1806222-8	5/26/18	Radium-226 (pCi/g)	168 M3	NA	17, p.194; 111, pp.12, 102; 220, p.221
Background Sample (BSA 22)								42, p.33; 43, p.2309
B22-SS04-01-052418	0-6”	Fine sand	1805626-7	5/24/18	Uranium (mg/kg)	1.3	0.01	43, pp. 6959,6960; 107, pp.6, 33; 220,

Table 38. Sample Description and Analytical Results for AOC 29								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
								pp.124, 133
AOC Sample – NA-0344B Burial Cell 344B-2								
T23-XS23-01-052118	0-3”	Waste rock sand	1805589-19	5/21/18	Uranium (mg/kg)	17	0.0099	42, p.159; 108, pp.5, 57; 220, p. 107

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC.

Number by which this AOC is to be identified: 30

Name of AOC: Mesa VI Mine Waste Pile M13A and Waste Pile M13B

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 12

AOC 30 comprises two waste piles: Mesa VI Mine Waste Pile M13A and Waste Pile M13B. Both waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history. Waste Pile M13A is in the eastern portion of the mine area. The lower portion of this waste pile is situated against a sandstone cliff and expands across the Cove Wash North drainage into the Mesa V New Lease area. Multiple drainages were mapped on Waste Pile M13A. A total average depth of 15 feet was estimated at Waste Pile M13A. Waste Pile M13B is in the western portion of the mine area. NA-0319 is next to Waste Pile M13B. The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation. Waste at the mine will migrate downhill into the Cove Wash North drainage. Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 13, p. 34; 43, p.2412). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations

above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-23 was selected as the most appropriate background location for AOC 30 because it is within the same geologic unit (Carmel Formation) and it hosts soil of the same type (Refs. 13, pp. 23,25,33; 43, p. 2392). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 103, pp.2,63,71,110,118).

Table 39. Sample Description and Analytical Results for AOC 30

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 23)								13, p.34; 43, p.2412
B23-SS15-01-060618	0-6”	Sandy silt	1806236-19	6/6/18	Arsenic (mg/kg)	27	0.2	43, p.6973; 85, pp. 6, 57; 220, p. 244
B23-SS25-01-060618	0-6”	Clayey sand	1806236-29	6/6/18	Uranium (mg/kg)	5.9	0.011	43, p.6974; 85, pp.6, 77; 220, p.245
BSA-23	0-6”	Silty sand	1806221	6/6/18	Radium-226 (pCi/g)	4.51*	NA	43, p.6970; 200. p.1; 85, p.10; 220, p.215
AOC Sample – Mesa VI Mine Waste Pile M13A								
M13-SS59-01-091518	0-6”	Waste rock sand	1809355-19	9/15/18	Uranium (mg/kg)	710	0.097	13, p. 203; 103, pp. 6, 71; 220, p. 917
M13-SS59-01-091518	0-6”	Waste rock sand	1809356-19	9/15/18	Radium-226 (pCi/g)	367 M3	NA	13, p.203; 103, pp.10, 118; 220, p.525
AOC Sample – Mesa VI Mine Waste Pile M13B								
M13-SS210-01-091518	0-6”	Waste rock sand	1809355-15	9/15/18	Arsenic (mg/kg)	190	0.19	13, p.205; 103, pp. 6, 63; 220, p. 917
M13-SS210-01-091518	0-6”	Waste rock sand	1809355-15	9/15/18	Uranium (mg/kg)	150	0.094	13, p.205; 103, pp.6, 63; 220, p.917

Table 39. Sample Description and Analytical Results for AOC 30								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
M13-SS210-01-091518	0-6”	Waste rock sand	1809356-15	9/15/18	Radium-226 (pCi/g)	64.1	NA	13, p.205; 103, pp.10, 110; 220, p.527

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC.

Number by which this AOC is to be identified: 31

Name of AOC: Cato No. 2 Waste Pile CO-04_NNWP01

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 12

AOC 31 comprises one waste pile: Cato No. 2 Waste Pile CO-04_NNWP01. This waste pile consists of material removed from the portal and pushed into an ore chute carved into the rock cliff and dropped to the bench below. This bench was likely built up over time from overburden and waste rock. The mine area is located on 20- to 35-degree slopes with a larger sheer cliff band through the center. The mine area benches are graded relatively flat. The lower portion of the mine area is accessed through NA-0319 (Ref. 75, pp. 6,7). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation. Waste at the mine will migrate downhill into the Cove Wash North drainage. Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the BRA (Ref. 75, pp.7,8). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

The Morrison Formation BRA was chosen by Cyprus Amax to best represent the background levels for AOC 31 (Refs. 63, p.63; 82, p.8). The highest concentration of each metal analyte from all samples collected from the

Morrison Formation BRA was chosen as the background level (Refs. 1, p.14, p.116; 82, p.6; 63, pp.63,65). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 140, pp.1178,1181,1304).

Table 40. Sample Description and Analytical Results for AOC 31

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Samples (Background – No. 1 Morrison)								75, p.6
SS-CO-B1-021-10142017	0-6”		1710392-23	10/14/17	Uranium (mg/kg)	1.5	0.01	169, pp. 13, 1401
Morrison Ra-226	0-6”		1710392	10/14/17	Radium-226 (pCi/g)	1.388*	NA	200, p.2; 169, p.13; 218, p.14
AOC Sample – Cato No. 2 Waste Pile CO-04_NNWP01								
SS-04-NNWP01-002-09202	0-6”	Waste	1809484-4	9/20/18	Uranium (mg/kg)	170	0.094	140, pp. 1145,1181
SS-04-NNWP01-002-09202	0-6”	Waste	1809484-4	9/20/18	Radium-226 (pCi/g)	67.4	NA	140, pp. 1145, 1304

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 32

Name of AOC: Frank Jr. Mine Waste Pile M14

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 12

AOC 32 comprises one waste pile: Frank Jr. Mine Waste Pile M14. This waste pile takes up most of the surface area at Frank Jr. Mine. The waste pile slopes steeply toward the Cove Wash North drainage and is eroding into the drainage. Offsite migration of waste material from Frank Jr. Mine was confirmed. The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation. Surficial

contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater (Ref. 223, p.20). The workings for Frank Jr. Mine extend south toward NA-0344B, which is a burial cell that was constructed between 2003 and 2004 (Refs. 14, p.27; 42, p.26).

All waste samples are surface samples collected from the waste pile but are generally referred to in the RSE report as soil samples. Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration. Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background study area (Refs. 14, p.34; 43, p.1898). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-18 was selected as the most appropriate background location for AOC 32 because it is within the same geologic unit (Carmel Formation) and it hosts soil of the same type (Refs. 14, pp. 23,33; 43, p. 1878). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 84, pp.2,55,108; 115, pp.2,13,15).

Table 41. Sample Description and Analytical Results for AOC 32

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 18)								14, p.34; 43, p.1898
B18-SS30-01-052518	0-6”	Silty sand	1805630-35	5/25/18	Arsenic (mg/kg)	3.6	0.22	43, pp. 6924, 6925; 104, pp.6,90; 220, p.146
B18-SS25-01-052518	0-6”	Silty sand	1805630-30	5/25/18	Uranium (mg/kg)	1.6	0.011	43, p.6925; 104, pp.6,79; 220, p.146
BSA-18	0-6”	Silty sand	1805631	5/25/18	Radium-226 (pCi/g)	1.76*	NA	43, p.6925; 200, p.1; 104, p.11; 220, p.152
AOC Samples – Frank Jr. Mine Waste Pile M14								
M14-SS69-01-091818	0-6”	Waste rock sand	1809426-9	9/18/18	Arsenic (mg/kg)	16	0.2	14, p.192; 84, pp.6,55; 220, p. 589
M14-XS40-01-052418	0-3”	Waste rock sand	1805632-2	5/24/18	Uranium (mg/kg)	130	0.099	14, p.177; 115, pp.5, 15; 220, p.158

Table 41. Sample Description and Analytical Results for AOC 32								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
M14-SS37-01-091818	0-6”	Silty sand	1809427-8	9/18/18	Radium-226 (pCi/g)	92 J-	NA	14, p.191; 84, p.6,108; 48, pp.7,8; 220, p.592

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

J- The analyte was detected at the reported concentration; the quantitation is an estimate and may be biased low. As a source sample, the concentration of this qualified data is reported without adjustment (Ref. 48, p.7, 8).

Description of Areas of Concern – Mesa V and Mesa VI

Given the interconnected nature of the ore bodies, similar mining processes, similar time frames of operation, and general geology of the LMMD site, the possible mining-related sources listed below may be releasing hazardous substances to the Cove Wash drainages or exposing human or terrestrial sensitive environment targets. The other areas of concern will be evaluated during further investigation of this area.

Table 42. Mesa V and Mesa VI Other Areas of Concern	
Area of Concern	**Description (Reference)**
NA-0318	NA-0318 is located southeast of Mesa V Adit, Mesa V Incline, and NA-0344B (Ref. 16, p.21). NA-0318 has one waste pile, one rimstrip, and one pit. The waste pile is in the eastern-southeastern portion of the mine area on a slope and is estimated to be 60 to 70 feet wide. Weston conducted a gamma scan in 2010, and the highest gamma measurement was 62,742 cpm. The highest background gamma level measured was 18,000 cpm (Ref. 54, pp. 2, 3, 4, 10, 11).
Cato No. 1 Pit	Cato No. 1 Pit is located northeast of Frank Jr. Mine (Figure 1). Cato No. 1 Pit has three waste piles, one rimstrip, and one pit. The mine was operational in 1951 (Ref. 55, pp.4,5,11,12). Weston conducted a gamma scan in 2010, and the highest gamma measurement was 428,784 cpm, which is significantly higher than the highest background gamma level measurement of 20,400 cpm (Ref. 55, pp.3,4,11,12).
NA-0319 #469	NA-0319 #469 is located northwest of Mesa V Adit. NA-0319 #469 contains three portals. Weston conducted a gamma scan in 2010, and the highest gamma measurement was 52,361 cpm, which is higher than the highest background gamma level measurement of 12,359 cpm (Ref. 46, pp.3,5,17,18).

Table 42. Mesa V and Mesa VI Other Areas of Concern	
Area of Concern	**Description (Reference)**
NA-0319 #612	NA-0319 #612 shares a southern border with Mesa VI Mine. The Cove Wash North drainage runs along the southern edge of the Mesa VI Mine boundary and flows directly through the mine boundary of NA-0319 #612. Waste Pile M31B is located near NA-0319 #612 (Ref. 13, pp.24,31,32). NA-0319 # 612 contains two waste piles located on steep slopes and one portal. Weston conducted a gamma scan in 2010, and the highest gamma measurement was 239,222 cpm, which is significantly higher than the highest background gamma level measurement of 12,359 cpm (Ref. 46, pp.4,6,17,18).

Areas of Observed Contamination 33 to 36 – Knife Edge Mesa

The Knife Edge Mesa area includes four AOCs that are associated with four mine claims and a mine-related area: Knife Edge Mesa Mine, Joleo Mine, Cisco Mine, Camp Mine, and NA-0343. NA-0343 is a mine-related area considered to be another area of concern needing further investigation.

Table 43. Knife Edge Mesa AOCs			
AOC No.	**AOC Type**	**Mine Claim Names**	**RSE Waste Pile Names**
33	Pile	Knife Edge Mesa Mine	Waste Pile M33
34	Pile	Camp Mine	Waste Pile M52
35	Pile	Cisco Mine	Waste Pile M53A and M53B
36	Pile	Joleo Mine	Waste Pile M54

According to Chenoweth, the Knife Edge Mesa Mine was operated by VCA only in 1966 (Ref. 187, p. 57). However, Roux Associates, Inc. states that this mine was also operated while owned and operated by Kerr-McGee (Ref. 33, p.25). Camp Mine was operated from 1953 through 1956 by Walter Duncan and from 1962 through 1963 by Robert Goode (Ref. 173, p.2). Similarly, Walter Duncan was the listed operator at Cisco Mine in 1953 and at Joleo Mine from 1952 through 1954 (Refs. 171, p.2; 172, p.2). Operations included underground mining that tapped paleochannels in the Salt Wash Member of the Lower Morrison Formation that are rich in uranium and vanadium. Underground mine workings exist within the Knife Edge Mesa area. Waste piles consist of overburden or lower grade protore discarded near or downslope of portals and adits (Refs. 33, p.26; 171, p.4; 172, p.4; 173, p.4).

The AOC at Knife Edge Mesa Mine was sampled as part of the USEPA RSE investigation in 2018 (Ref. 33, pp. 9, 11, 134). The other three AOCs in the Knife Edge Mesa area (Camp Mine, Cisco Mine, and Joleo Mine) were sampled during a NPL sampling event in 2022 (Ref. 186, pp. 1, 2, 3, 4). One background surface soil sample (KNIFE BG-01) was collected during the 2022 sampling event. NA-0343 was partially scanned in 2010, but no soil sampling was conducted at the mine by USEPA.

Number by which this AOC is to be identified: 33

Name of AOC: Knife Edge Mesa Mine Waste Pile M33

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 13

AOC 33 comprises one waste pile: Knife Edge Mesa Mine Waste Pile M33. Knife Edge Mesa Mine is a former uranium and vanadium underground mine (33, pp.18, 26). Waste Pile M33 extends downslope for approximately 50 yards from the former portal at the Knife Edge Mesa Mine. The waste pile slopes steeply and off the edge of a cliff and into the Knife Edge Wash below (33, pp. 20, 26, 27). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile (Ref. 136, pp.50,51,71,120). Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest AOC-specific background concentration (Refs. 43, p.7041; 137, pp.6,71). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 43, p.7037; 137, p.10; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-32 was selected as the most appropriate background location for AOC 33 because it is within the same geologic unit (Undifferentiated Summerville, Todilto, Entrada Formation) and it hosts soil of the same type (Ref. 33, p.22). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 137, pp.71,158). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 137, p.71, 158; 200, pp.2,3,5).

Table 44. Sample Description and Analytical Results for AOC 33

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 32)								33, p.33; 43, p.3247
B32-SS23-01-071218	0-6”	Sandy gravel	1807330-26	7/12/18	Uranium (mg/kg)	21	0.01	43, p.7041; 137, pp.6, 71; 220, p. 347
BSA-32	0-6”	Silty sand	1807331	7/12/18	Radium-226 (pCi/g)	15.06*	NA	43, p.7037; 200, p.2; 137, p.10; 220, p.352
AOC Samples – Knife Edge Mesa Mine Waste Pile M33								
M33-SS97-01-091818	0-6”	Waste rock sand	1809418-19	9/18/18	Uranium (mg/kg)	230	0.097	33, p.187; 136, pp.5, 71; 220, p. 568
M33-SS97-01-091818	0-6”	Waste rock sand	1809419-19	9/18/18	Radium-226 (pCi/g)	152 M3	NA	33, p.187; 136, pp. 12,120; 220, p.571

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).
2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).
* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).
M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC.
NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 34

Name of AOC: Camp Mine Waste Pile M52

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 13

AOC 34 comprises one waste pile: Camp Mine Waste Pile M52. Camp Mine was operational from approximately 1953 to 1963. Historical documents show the operator of the mine as Walter Duncan from 1953 to 1956 and Robert Goode from 1962 to 1963. While operational, the mine had a total reported production volume of 18,853 tons of uranium ore (Ref. 173, pp. 2, 5). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile (Ref. 186, pp.18,19,20,25-27,35,45,51,303). Observed contamination is established by analytical significance above background levels. For metals, background levels are determined based on comparison to the highest background concentration from the background sample collected during the same sampling event (Refs. 1, pp.13,14; 186, pp.1,35,65). All AOC sample results for Ra-226 exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 186, pp.35,37). Ra 226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 186, pp.280,282; 200, pp.3,5).

Table 45. Sample Description and Analytical Results for AOC 34

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Knife BG-01)								186, p.1
KNIFE-SSBG01-072122	0-3”	Red sand	2207536-11	7/21/22	Arsenic (mg/kg)	0.77	0.19	186, pp.29,30,35, 66
KNIFE-SSBG01-072122	0-3”	Red sand	2207536-11	7/21/22	Lead (mg/kg)	2.6	0.19	186, pp.29,30,35, 66

Table 45. Sample Description and Analytical Results for AOC 34								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
KNIFE-SSBG01-072122	0-3”	Red sand	2207536-11	7/21/22	Uranium (mg/kg)	0.24	0.019	186, pp.29,30,35, 66
Upper-limit range of regional background					Radium-226 (pCi/g)	2.23	NA	200, pp. 2,3
AOC Samples – Camp Mine Waste Pile M52								
208-SSW01-01-071922	0-3”	Waste rock sand	2207536-1	7/19/22	Arsenic (mg/kg)	6.2	0.2	186, pp.25,27,35,45
208-SSW01-01-071922	0-3”	Waste rock sand	2207536-1	7/19/22	Lead (mg/kg)	31	0.2	186, pp.25,27,35,45
208-SSW04-01-071922	0-3”	Waste rock sand	2207536-4	7/19/22	Uranium (mg/kg)	8,400	2	186, pp. 26, 27, 35, 52
208-SSW04-01-071922	0-3”	Waste rock sand	2207537-4	7/19/22	Radium-226 (pCi/g)	1,310 M3	NA	186, pp.26,27,35,303

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC.

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 35

Name of AOC: Cisco Mine Waste Pile M53A and Waste Pile M53B

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 13

AOC 35 comprises two waste piles: Cisco Mine Waste Pile M53A and Waste Pile M53B. Both waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history. Waste Pile M53A is in the eastern portion of the mine area. The waste piles extend around a point on the mesa (Ref. 186, p.6). Cisco Mine was operated in 1953. Historical documents show the operator of the mine as Walter Duncan in 1953 (Refs. 172, p. 5; 186, p. 6). Surficial

contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste piles (Ref. 186, p. 1). Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the background concentration (Ref. 186, pp.1,2,3,6,23,29,30,35,66,318). For metals, background levels are determined based on comparison to the highest background concentration from the background sample collected during the same sampling event (Refs. 1, pp.13,14; 186, pp.1,35,65). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 186, pp.35,37). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 186, pp.280,282; 200, pp.3,5).

Table 46. Sample Description and Analytical Results for AOC 35

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Knife BG-01)								186, pp.1, 2
KNIFE-SSBG01-072122	0-3”	Unavailable	2207536-11	7/21/22	Arsenic (mg/kg)	0.77	0.19	186, pp.29,30, 35,65
KNIFE-SSBG01-072122	0-3”	Unavailable	2207536-11	7/21/22	Lead (mg/kg)	2.6	0.19	186, pp.29,30,
KNIFE-SSBG01-072122	0-3”	Unavailable	2207536-11	7/21/22	Uranium (mg/kg)	0.24	0.019	186, pp.29,30,
Upper-limit range of regional background					Radium-226 (pCi/g)	2.23	NA	200, pp. 2,3
AOC Samples – Cisco Mine Waste Piles M53A and M53B								
429-SSW01-01-072122	0-3”	Waste rock sand	2207536-5	7/21/22	Arsenic (mg/kg)	5.5	0.2	186, pp.29,30, 35
429-SSW01-01-072122	0-3”	Waste rock sand	2207536-5	7/21/22	Lead (mg/kg)	16	0.2	186, pp.29,30, 35
429-SSW01-01-072122	0-3”	Waste rock sand	2207536-5	7/21/22	Uranium (mg/kg)	490	0.2	186, pp.29,30, 35
429-SSW01-01-072122	0-3”	Waste rock sand	2207537-5	7/21/22	Radium-226 (pCi/g)	184 M3	NA	186, pp.29,30, 35,305

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).
2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).
M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC.
NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 36

Name of AOC: Joleo Mine Waste Pile M54

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 13

AOC 36 comprises one waste pile: Joleo Mine Waste Pile M36. Joleo Mine was identified as being operational from 1952 to 1954. Historical documents show the operator of the mine as Walter Duncan from 1952 to 1954. While operational, the mine had a total reported production volume of 10,751 tons of uranium ore (Ref. 171, p.5). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile (Ref. 186, p.1). Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the highest background concentration (Ref. 1, pp.13,14). Background levels are determined based on the highest analyte-specific background concentration from the AOC-specific background sample from the same sampling event (Refs. 186, pp.1,35,65). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 186, pp.35,37). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 186, pp.280,282; 200, pp.3,5).

Table 47. Sample Description and Analytical Results for AOC 36

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Knife BG-01)								186, p.1
KNIFE-SSBG01-072122	0-6”	Unavailable	2207536-11	7/21/22	Arsenic (mg/kg)	0.77	0.19	186, pp.29,30,35
KNIFE-SSBG01-072122	0-6”	Unavailable	2207536-11	7/21/22	Lead (mg/kg)	2.6	0.19	186, pp.29,30,35

Table 47. Sample Description and Analytical Results for AOC 36								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
KNIFE-SSBG01-072122	0-6”	Unavailable	2207536-11	7/21/22	Uranium (mg/kg)	0.24	0.019	186, pp.29,30,35
Upper-limit range of regional background					Radium-226 (pCi/g)	2.23	NA	200, pp. 2,3
AOC Samples – Joleo Mine Waste Pile M54								
467-SSW01-01-072122	0-6”	Waste rock sand	2207536-8	7/21/22	Arsenic (mg/kg)	11	0.2	186, pp.28,30,35
467-SSW03-01-072122	0-6”	Waste rock sand	2207536-10	7/21/22	Lead (mg/kg)	13	0.2	186, pp.28,30,35,
467-SSW03-01-072122	0-6”	Waste rock sand	2207536-10	7/21/22	Uranium (mg/kg)	920	0.2	186, pp.28,30,35
467-SSW03-01-072122	0-6”	Waste rock sand	2207537-10	7/21/22	Radium-226 (pCi/g)	273 M3	NA	186, pp.28,30,35,

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the upper-limit range of regional background (Ref. 200, pp.2,3).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC.

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Description of Areas of Concern – Knife Edge Mesa

Given the interconnected nature of the ore bodies, similar mining processes, similar time frames of operation, similar gamma radiation signature, and general geology of the LMMD site, the other areas of concern listed below are likely to have releases of hazardous substances, exposing human and terrestrial sensitive environment targets. The other possible sources and AOCs will be evaluated during further investigation of this area. Figure 13 shows the location of the Knife Edge Mesa area of concern.

Table 48. Knife Edge Mesa Other Areas of Concern	
Area of Concern	**Description (Reference)**
NA-0343	NA-0343 is located approximately 230 feet southeast of Knife Edge Mesa Mine on the back side of the Lukachukai Mountains (Ref. 33, p.18). The area contains waste debris downslope of an adit (Ref. 49, pp.4,10,11). Weston conducted a gamma scan in 2010, and the highest gamma measurement was 999,960 cpm, which is significantly higher than the highest background gamma level measurement of 11,023 cpm (Ref. 49, pp.3,10,11).

Areas of Observed Contamination – Flag Mesa Area

The Flag Mesa area includes three AOCs associated with four mine claims:

Table 49. Flag Mesa Area AOCs			
AOC No.	**AOC Type**	**Mine/Claim Names**	**RSE Waste Pile Names**
37	Pile	Flag No. 1 Mine	Waste Piles M37A and M37B
38	Pile	Black No. 1 Mine	Waste Piles M34A and M34B
39	Pile	Black No. 2 Mine and Black No. 2 Mine West	Waste Piles M35A, M35B, M35C, and M36

The mine claims in the Flag Mesa area were developed and operated from 1953 through 1966. Flag No. 1 Mine was operated by the Navajo Uranium Mining Company and Kerr-McGee between 1953 and 1957 and by VCA from 1964 through 1966; the operator from 1953 through 1957 is unknown. Black No. 1 Mine was operated by Kerr-McGee in 1955. Black No. 2 Mine was operated from 1955 through 1957 by Kerr-McGee under mine permit 239 issued to Koley Black. No production took place at Black No. 2 Mine from 1958 and 1963, but the mine was reopened and operated by VCA from 1963 through 1964. Black No. 2 Mine West was operated by Kerr-McGee in 1955, which was the only year the mine recorded ore production. However, Black No. 2 Mine West is assumed to have been grouped under the Black No. 2 Mine lease. Operations included underground mining that tapped paleochannels in the Salt Wash Member of the Lower Morrison Formation that are rich in uranium and vanadium. Underground mine workings exist within the Flag Mesa area. Waste piles consist of overburden or lower grade protore discarded near or downslope of portals (Refs. 34, pp.25,26,30; 35, pp.25,26,30; 36, pp.25,26,30; 37, pp.25,27,30).

Soil is the only sample medium for background samples, and mine waste is the medium for the AOC samples referenced below. Only surface sample results (6 inches or shallower) are presented below.

Number by which this AOC is to be identified: 37

Name of AOC: Flag No. 1 Mine Waste Pile M37A and Waste Pile M37B

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 14

AOC 37 comprises two waste piles: Flag No. 1 Mine Waste Pile M37A and Waste Pile M37B. Both waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history. Waste Pile M37B is part of Waste Pile M37A except that the piles are separated by a cliff; overflow waste from Waste Pile M37A has fallen downhill to create Waste Pile M37B on a geographically lower bench (Ref. 37, p.27). Flag No. 1 Mine was operated by Navajo Uranium Mining Company and Kerr-McGee between 1953 and 1957 and by VCA between 1964 and 1966; the operator from 1957 to 1964 is currently unknown. In total, the mine produced 11,286 tons of ore (Ref. 37, p.25). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile (Ref. 37, p.136; 134, pp.5,9,50,91). Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the background concentration (Refs. 1, p.13; 43, p.7041). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-32 was selected as the most appropriate background location for AOC 38 because it is within the same geologic unit (undifferentiated Summerville and Entrada Formations) and it hosts soil of the same type (Ref. 34, p.22). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 134, p.2). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 134, p.2; 200, pp.2,3,5).

Table 50. Sample Description and Analytical Results for AOC 37

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 32)								34, p.33; 43, p.3249
B32-SS23-01-071218	0-6”	Sandy gravel	1807330-26	7/12/18	Uranium (mg/kg)	21	0.01	43, p.7041; 137, pp.6,71; 220, pp.343, 344
BSA-32	0-6”	Silty sand	1807331	7/12/18	Radium-226 (pCi/g)	15.06*	NA	43, pp.7036, 7037; 200, p.2; 137, p.10; 220, p.352
AOC Samples – Flag No. 1 Mine Waste Pile M37A and Waste Pile M37B								
M37-XS124A-01-081318	0-3”	Waste rock sand	1808303-16	8/13/18	Uranium (mg/kg)	240	0.095	37, p.165; 134, pp.5,50; 220, pp.422, 423

Table 50. Sample Description and Analytical Results for AOC 37								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
M37-XS124 A-01-081318	0-3”	Waste rock sand	1808302-16	8/13/18	Radium-226 (pCi/g)	145 M3	NA	37, p.165; 134, pp.9,91; 220, pp.417, 418

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC (Ref. 134, p. 91).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 38

Name of AOC: Black No. 1 Mine Waste Pile M34A and Waste Pile M34B

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 14

AOC 38 comprises two waste piles: Black No. 1 Mine Waste Pile M34A and Waste Pile M34B. Both waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history. Waste Pile M34B is part of Waste Pile M34A except that the piles are separated by a cliff; overflow waste from Waste Pile M34A has fallen downhill to create Waste Pile M34B on a geographically lower bench (Ref. 34, p.26). The Black No. 1 Mine was operated in 1955 by Kerr-McGee and produced 1,047 tons of ore (Ref. 34, p.25). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile (Ref. 34, p.12; 134, pp.5,9,50,91). Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the background concentration (Refs. 1, p.13,14; 43, p.7041). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, p.116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSA-32 was selected as the most appropriate background location for AOC 38 because it is within the same geologic unit (undifferentiated Summerville and Entrada Formations) and it hosts soil of the same type (Ref. 34, p.22). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846

6020A ICP-MS (Ref. 101, p.2). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 101, p.2; 200, pp.2,3,5).

Table 51. Sample Description and Analytical Results for AOC 38

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 32)								34, p.33; 43, p.3247
B32-SS23-01-071218	0-6”	Sandy gravel	1807330-26	7/12/18	Uranium (mg/kg)	21	0.01	43, p.7041; 137, pp.6,71; 220, pp.343, 344
BSA-32	0-6”	Silty sand	1807331	7/12/18	Radium-226 (pCi/g)	15.06*	NA	43, pp.7036, 7037; 137, p.10; 200, p.2; 220, p.352
AOC Samples – Black No. 1 Mine Waste Pile M34A and Waste Pile M34B								
M34-SS109-01-092718	0-6”	Silty sand	1810080-4	9/27/18	Uranium (mg/kg)	190	0.1	34, p.189; 101, pp.7,54; 220, pp.799, 800
M34-SS109-01-092718	0-6”	Silty sand	1810079-4	9/27/18	Radium-226 (pCi/g)	122 M3	NA	34, p.189; 101, pp.17,157; 220, pp.791, 792

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC (Ref. 101, p. 157).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 39

Name of AOC: Black No. 2 Mine and Black No. 2 Mine West Waste Pile M35A, Waste Pile M35B, Waste Pile M35C, and Waste Pile M36

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 14

AOC 39 comprises four waste piles: Black No. 2 Mine and Black No. 2 Mine West Waste Pile M35A, Waste Pile M35B, Waste Pile M35C, and Waste Pile M36. All four waste piles are aggregated into a single AOC because of their proximity, similar waste type, same AOC type, impacts on the same targets, and similar past operational history. Kerr-McGee began production of the two Black Mesa mine claims located on the south side of the Lukachukai Mountains in 1955. This was the only year the mines were identified as producing ore. Black No. 2 Mine (also known as Bare Rock Mesa Mine) is contiguous with Black No. 2 Mine West and under Koley Black's MP-239 lease (Ref. 187, p.63). Black No. 2 Mine West production was grouped under this lease with Black No. 2 Mine for a total of 1,879 tons of ore produced (Ref. 187, p. 63). The two sites together had two primary portals, one of which was accessible and one of which was not. Both were open with highwalls and had associated waste piles and wooden debris and structures (Ref. 35, p.28). Surficial contamination documented in the AOC sample results below shows that the waste piles do not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile (Ref. 35, p.163). Observed contamination is established by analytical significance above background levels. For surface waste samples analyzed for metals, observed contamination is established when the metal concentration is three times the background concentration (Refs. 1, p.13,14; 43, p.7041). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, p.116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

BSAs 32 and 33 are approximately equidistant from AOC 39, therefore data from both BSAs are provided. All AOC samples exceed the highest value from both BSAs. The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Ref. 134, p.2). Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 134, p.2; 200, pp.2,3,5).

Table 52. Sample Description and Analytical Results for AOC 39

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 33)								35, p.33; 43, p.3357
B33-SS08-01-071618	0-6"	Silty sand	1807367-11	7/16/18	Uranium (mg/kg)	1.9	0.011	43, p.7047; 138, pp.6,40; 220, pp.401, 402
BSA-33	0-6"	Silty sand	1807368	7/16/18	Radium-226 (pCi/g)	1.98*	NA	43, pp.7044,

Table 52. Sample Description and Analytical Results for AOC 39								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
								7045; 138, p.10; 200, p.2; 220, p.407
AOC Samples – Black No. 2 Mine Waste Pile M35A, Waste Pile M35B, and Waste Pile M35C								
M35-XS74-01-081318	0-3”	Waste rock sand	1808303-10	8/13/18	Uranium (mg/kg)	90	0.093	35, p.163; 134, pp.5, 38; 220, pp.422, 423
M35-XS74-02-081318	0-3”	Waste rock sand	1808302-11	8/13/18	Radium-226 (pCi/g)	102 M3	NA	35, p.163; 134, pp.9, 81; 220, pp.417, 418
Background Sample (BSA 32)								34, p.33; 43, p.3247
B32-SS23-01-071218	0-6”	Sandy gravel	1807330-26	7/12/18	Uranium (mg/kg)	21	0.01	43, p.7041; 137, pp.6, 71; 220, pp.343, 344
BSA-32	0-6”	Silty sand	1807331	7/12/18	Radium-226 (pCi/g)	15.06*	NA	43, p.7041; 137, p.10; 200, p.2; 220, p.352
AOC Samples – Black No. 2 Mine, West Waste Pile M36								
M36-XS31-01-081218	0-3”	Waste rock sand	1808303-15	8/12/18	Uranium (mg/kg)	110	0.097	36, p.170; 134, pp.5, 48; 220, pp.422, 423
M36-XS31-01-081218	0-3”	Waste rock sand	1808302-15	8/12/18	Radium-226 (pCi/g)	107 M3	NA	36, p.170; 134, pp.9, 89; 220, pp.417, 418

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).s

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC (Ref. 134, p. 81).
NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Areas of Observed Contamination 40 to 43 – Step Mesa

Four AOCs are scored as a result of mining activities at Step Mesa.

Table 53. Step Mesa AOCs

AOC No.	AOC Type	Mine/Claim Names	RSE Waste Pile Names
40	Pile	Step Mesa Mine	Step Mesa Mine Waste Pile M38
41	Pile	Jimmie King No. 9	Jimmie King No. 9 Waste Pile
42	Pile	NA-0332	NA-0332 Waste Pile
43	Pile	NA-0333	NA-0333 Waste Pile

All mine claims and mine-related areas are in the Step Mesa geographic area (Ref. 38, p.20). In 1961, Kerr-McGee acquired the Tommy James Mine mining permit (MP-109) lease and began to develop the area. VCA acquired the Step Mesa Mine lease in 1963 and continued operating the area through 1964 (Ref. 38, p.25). Tommy James Mine was operated by Price Exploration from 1955 through 1956 (Ref. 39, p.18). Jimmie King No. 9 Mine (also known as NA-0334) was operated by Warren and Dye from 1956 through 1957 and by E.D. Warren in 1957 (Ref. 170, p. 2). Operations included underground mining that tapped paleochannels in the Salt Wash Member of the Lower Morrison Formation that are rich in uranium and vanadium (Refs. 38, p.22; 39, p.15). Underground mine workings exist throughout the Step Mesa area. Waste piles consist of overburden or lower grade protore discarded near or downslope of portals (Refs. 38, p.30; 39, p.23; 183, p.18). Mine-related features NA-0332 and NA-0333 were identified by NAML under the Northern Navajo Cove 4 Project in 2004 (Refs 65, p.71; 215, p. 3; 216. P. 3). Waste Pile NA-0332 is located east of Tommy James Mine, and Waste Pile NA-0333 is located north of Waste Pile NA-0332 (Figure 15).

Soil is the only sample medium for background samples, and mine waste is the medium for the AOC samples referenced below. Waste pile observed contamination is established by analytical significance as compared to surface soil background levels (Ref. 1, p.14). Only surface sample results (6 inches or shallower) are presented below. Select other possible AOC samples are presented below to demonstrate that the observed contamination criteria are met.

Number by which this AOC is to be identified: 40

Name of AOC: Step Mesa Mine Waste Pile M38

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 15

AOC 40 comprises one waste pile: Step Mesa Mine Waste Pile M38. The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 38, p.27). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples collected from the waste pile. Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). For surface waste samples analyzed for metals, samples are compared to the highest background concentrations for each analyte from surface background samples near the AOC (Refs. 35, p.33; 43, p.3355). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 38, p.170; 43, pp.7045,7047,7048; 98, pp.7,14,113,206; 138, pp. 6,10,40,44).

BSA-33 was selected as the most appropriate background location for AOC 40 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Refs. 43, pp. 3338; 212, p. 1). The highest background concentration for each metals analyte from the 30 samples comprising BSA-33 was used as the background level for AOC 40 (Ref. 43, p.3358). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-33 was used as the background level for AOC 40 (Refs. 43, pp. 3361; 200, p.2).

Table 54. Sample Description and Analytical Results for AOC 40

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 33)								35, p.33; 43, pp. 3355, 3357
B33-SS10-01-071618	0-6”	Sand	1807367-13	7/16/18	Arsenic (mg/kg)	1.7	0.21	43, p.7048; 138, pp.6, 44; 220, pp.401, 402, 404
B33-SS08-01-071618	0-6”	Silty sand	1807367-11	7/16/18	Uranium (mg/kg)	1.9	0.011	43, p.7047; 138, pp.6, 40; 220, pp.401, 402, 404
BSA-33	0-6”	Silty sand	1807368	7/16/18	Radium-226 (pCi/g)	1.98*	NA	43, pp.7044, 7045; 200, p.2; 138, p.10; 220, p.407
AOC Samples – Step Mesa Mine Waste Pile M38								
M38-SS2-01-092718	0-6”	Silty sand	1810026-36	9/27/18	Arsenic (mg/kg)	13	0.19	38, p.170; 98, pp.7, 113; 220, pp.726,

Table 54. Sample Description and Analytical Results for AOC 40								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
								728, 731, 732
M38-SS2-01-092718	0-6”	Silty Sand	1810026-36	9/27/18	Uranium (mg/kg)	30	0.0095	38, p.170; 98, pp.7, 113; 220, pp.726, 728, 731, 732
M38-SS2-01-092718	0-6”	Silty sand	1810027-36	9/27/18	Radium-226 (pCi/g)	36.7	NA	38, p.170; 98, pp.14, 206; 220, pp.736, 738

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 41

Name of AOC: Jimmie King No. 9 Mine Waste Pile

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 15

AOC 41 comprises one waste pile: Jimmie King No. 9 Mine Waste Pile. Jimmie King No. 9 Mine was operational from 1956 to 1957. Historical documents show the operator of the mine as Warren and Dye from 1956 to 1957 and E.D. Warren in 1957. While operational, the mine had a total reported ore production volume of 80 tons (Ref. 170, p.5). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Refs. 170, pp.6,10). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples from the waste pile. Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). For surface waste samples analyzed for metals, samples are compared to the highest background concentrations for each analyte from surface background samples near the AOC (Refs. 35, p.33; 43, p.3355). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was

performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 43, pp.7045,7047,7048; 138, pp.6,10,40,44; 197, pp.6,19; 204, pp.6,24).

BSA-33 was selected as the most appropriate background location for AOC 41 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Refs. 43, pp. 3338; 212, p. 1). The highest background concentration for each metals analyte from the 30 samples comprising BSA-33 was used as the background level for AOC 41 (Ref. 43, p.3358). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-33 was used as the background level for AOC 41 (Refs. 43, pp. 3361; 200, p.2).

Table 55. Sample Description and Analytical Results for AOC 41

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 33)								35, p.33; 43, p.3355
B33-SS10-01-071618	0-6”	Sand	1807367-13	7/16/18	Arsenic (mg/kg)	1.7	0.21	43, p.7048; 138, pp.6,44; 220, p. 404
B33-SS08-01-071618	0-6”	Silty sand	1807367-11	7/16/18	Uranium (mg/kg)	1.9	0.011	43, p.7047; 138, pp.6,40; 220, p. 404
BSA-33	0-6”	Silty sand	1807368	7/16/18	Radium-226 (pCi/g)	1.98*	NA	43, p.7045; 200, p.2; 138, p.10; 220, p.407
AOC Samples – Jimmie King No. 9 Mine Waste Pile								
200-SSW01-01-100422	0-6”	Waste rock sand	596530001	10/04/22	Arsenic (mg/kg)	18.5	1.0	212, pp. 12, 13, 23, 35
200-SSW01-01-100422	0-6”	Waste rock sand	596530001	10/04/22	Uranium (mg/kg)	2,450	0.83	212, pp. 12, 13, 23, 35
200-SSW01-01-100422	0-6”	Waste rock sand	596534001	10/04/22	Radium-226 (pCi/g)	319	NA	212, pp.13,890,908

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 42

Name of AOC: NA-0332 Waste Pile

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 15

AOC 42 comprises one waste pile: Waste Pile NA-0332. The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Refs. 60, p.4; 212, p.1). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples from the waste pile. Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). For surface waste samples analyzed for metals, samples are compared to the highest background concentrations for each analyte from surface background samples near the AOC (Refs. 35, p.33; 43, p.3355). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 43, pp.7045,7047,7048; 138, pp. 6,10,40,44; 200, p.2; 197, pp.6,32,35,37; 204, pp.6,32).

BSA-33 was selected as the most appropriate background location for AOC 42 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Refs. 43, pp. 3338; 212, p. 1). The highest background concentration for each metals analyte from the 30 samples comprising BSA-33 was used as the background level for AOC 42 (Ref. 43, p.3358). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-33 was used as the background level for AOC 42 (Refs. 43, pp. 3361; 200, p.2).

Table 56. Sample Description and Analytical Results for AOC 42

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 33)								35, p.33; 43, p.3355
B33-SS10-01-071618	0-6”	Sand	1807367-13	7/16/18	Arsenic (mg/kg)	1.7	0.21	43, p.7048; 138, pp. 6, 44; 220, p. 404
B33-SS08-01-071618	0-6”	Silty sand	1807367-11	7/16/18	Uranium (mg/kg)	1.9	0.011	43, p.7047; 138, pp. 6,

Table 56. Sample Description and Analytical Results for AOC 42								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
								40; 220, p. 404
BSA-33	0-6”	Silty sand	1807368	7/16/18	Radium-226 (pCi/g)	1.98*	NA	43, p.7045; 200, p.2; 138, p.10; 220, p.407
AOC Samples – NA-0332 Waste Pile								
202-SSW03-01-100422	0-3”	Waste rock sand	596530010	10/04/22	Arsenic (mg/kg)	18.5	0.96	212, pp. 12, 15, 23, 53
202-SSW02-01-100422	0-6”	Waste rock sand	596530009	10/04/22	Uranium (mg/kg)	1,290	0.40	212, pp. 12, 15, 23, 51
202-SSW02-01-100422	0-6”	Waste rock sand	596534009	10/04/22	Radium-226 (pCi/g)	406	NA	212, pp.15,890, 916

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2. The reporting limit is equivalent to the sample quantitation limit as defined by HRS, section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 43

Name of AOC: NA-0333 Waste Pile

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 15

AOC 43 comprises one waste pile: Waste Pile NA-0333. The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Refs. 61, p.4; 212, p.1). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples from the waste pile. Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). For surface waste samples analyzed for metals, samples are compared to the highest background concentrations for each analyte from surface background samples near the AOC (Refs. 35, p.33; 43, p.3355). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 43, pp. 7045,7047,7048; 138, pp. 6,10,40,44; 200, p. 2; 197, pp.6,27,31; 204, pp. 6,30).

BSA-33 was selected as the most appropriate background location for AOC 43 because it is within the same geologic unit (Morrison Formation), it hosts soil of the same type, and it is the closest BSA to the AOC (Refs. 43, pp. 3338; 212, p. 1). The highest background concentration for each metals analyte from the 30 samples comprising BSA-33 was used as the background level for AOC 43 (Ref. 43, p.3358). The Ra-226 mean plus two standard deviations from the 30 samples comprising BSA-33 was used as the background level for AOC 43 (Refs. 43, pp. 3361; 200, p.2).

Table 57. Sample Description and Analytical Results for AOC 43

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 33)								35, p.33; 43, p.3355
B33-SS10-01-071618	0-6”	Sand	1807367-13	7/16/18	Arsenic (mg/kg)	1.7	0.21	43, p.7048; 138, pp. 6, 44; 220, p. 404
B33-SS08-01-071618	0-6”	Silty sand	1807367-11	7/16/18	Uranium (mg/kg)	1.9	0.011	43, p.7047; 138, pp. 6, 40; 220, p. 404
BSA-33	0-6”	Silty sand	1807368	7/16/18	Radium-226 (pCi/g)	1.98*	NA	43, p.7045; 200, p.2; 138, p.10; 220, p.407
AOC Samples – NA-0333 Waste Pile								
201-SSW02-02-100422	0-3”	Waste rock sand	596530005	10/04/22	Arsenic (mg/kg)	16.1	0.94	212, pp. 12, 14, 22, 43
201-SSW03-01-100422	0-3”	Waste rock sand	596530007	10/04/22	Uranium (mg/kg)	2,040	0.41	212, pp. 12, 14, 22, 47
201-SSW03-01-100422	0-3”	Waste rock sand	596534007	10/04/22	Radium-226 (pCi/g)	480	NA	212, pp. 12, 14, 890, 914

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).
2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).
* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).
NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Description of Other Areas of Concern – Step Mesa

Given the interconnected nature of the ore bodies, similar mining processes, similar time frames of operation, and general geology of the LMMD site, the other area of concern listed below may be releasing hazardous substances to drainages below or exposing human or terrestrial sensitive environment targets. The other area of concern will be evaluated during further investigation of this area. Figure 15 shows the location of the other area of concern at Step Mesa area.

Table 58. Step Mesa Other Areas of Concern

Other Area of Concern	Description (Reference)
Tommy James Mine Waste Pile M39A and Waste Pile M39B	Field sampling activities at Tommy James Mine excluded both inaccessible waste piles (Ref. 183, p.18)

Areas of Observed Contamination 44 to 48 – Mexican Cry Mesa

Five AOCs are scored as a result of mining activities at Mexican Cry Mesa.

Table 59. Mexican Cry Mesa AOCs

AOC No.	AOC Type	Mine Claim Names	RSE Waste Pile Names
44	Pile	Mexican Cry Mine – 197	Mexican Cry 197 Waste Pile
45	Pile	Mexican Cry Mine – 198	Mexican Cry 198 Waste Pile
46	Pile	Hall Mine	Hall Mine Waste Pile
47	Pile	Nakai Chee Begay Mine	Nakai Chee Begay Waste Pile
48	Pile	Tom Joe No. 6	Tom Joe No. 6 Waste Pile

All mine claims in the Mexican Cry Mesa geographic area were developed and operated from 1955 through 1963. Mexican Cry Mine – 197 and Mexican Cry Mine – 198 were operated by the Texas Mining Company in 1955 (Ref. 176, p.2). Hall Mine was operated by W.B. Hall from 1956 through 1958 (Ref. 177, p.2). Nakai Chee Begay Mine was operated by Marcy Exploration from 1955 through 1956, J.W. Hall in 1956, and W.B. Hall from 1956 through 1960 (Ref. 178, p.2). Tom Joe No. 6 was operated by James W. Hall in 1963 (Ref. 179, p.2). Operations included underground mining that tapped paleochannels in the Salt Wash Member of the Lower Morrison Formation that are rich in uranium and vanadium (Ref. 187, p. 33). Underground mine workings exist within the Mexican Cry Mesa area. Waste piles consist of overburden or lower grade protore discarded near or downslope of portals (Refs. 176, p.5; 177, p.4; 178, p.4; 179, p.4).

Number by which this AOC is to be identified: 44

Name of AOC: Mexican Cry Mine 197 Waste Pile

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 16

AOC 44 comprises one waste pile: Mexican Cry Mine 197 Waste Pile. Mexican Cry Mine consists of two mine claims, Mexican Cry Mine – 197 and Mexican Cry Mine – 198. Mexican Cry Mine – 197 was operated in 1955 by the Texas Mining Company. While operational, the mine had a total reported ore production volume of 57 tons (Ref. 176, p. 7). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 213, p.1). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples from the waste pile. Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). For surface waste samples analyzed for metals, samples are compared to the highest background concentrations for each analyte from surface background sample MexCry-SSBG-01-092922 which is the nearest background sample to the AOC (Refs. 196, pp.6,20; 203, pp.6,22). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra 226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 194, pp. 6,24,26; 201, pp.6,25).

Table 60. Sample Description and Analytical Results for AOC 44

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Background – MexCry BG-01)								
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Arsenic (mg/kg)	0.829 BN	0.96	213, pp. 22, 28, 35
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Uranium (mg/kg)	0.408*	0.039	213, pp. 22, 28, 35
Upper-limit range of regional background					Radium-226 (pCi/g)	2.23	NA	200, pp. 2,3
AOC Samples – Mexican Cry Mine 197 Waste Pile								
197-SSW02-01-092822	0-6”	Waste rock sand	596484003	9/28/22	Arsenic (mg/kg)	8.9	0.98	213, pp. 17, 1556, 1573
197-SSW03-	0-6”	Waste rock sand	596484004	9/28/22	Uranium (mg/kg)	445	0.040	213, pp. 17, 1556, 1575

Table 60. Sample Description and Analytical Results for AOC 44								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
01-092822								
197-SSW03-01-092822	0-6”	Waste rock sand	596507004	9/28/22	Radium-226 (pCi/g)	71.2	NA	213, pp.17, 2147, 2166

* A quality control analyte recovery is outside of the specified acceptance criteria.
1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).
2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).
B Either the analyte was detected in the associated blank or MDL/IDL < sample value < PQL.
N The matrix spike sample recovery is not within the specified control limits.
NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 45

Name of AOC: Mexican Cry Mine 198 Waste Pile

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 16

AOC 45 comprises one waste pile: Mexican Cry Mine 198 Waste Pile. Mexican Cry Mine consists of two mine claims, Mexican Cry Mine – 197 and Mexican Cry Mine – 198. Mexican Cry Mine – 198 was operated in 1955 by the Texas Mining Company in 1955. The reported ore production tonnage of 57 tons is likely combined with Mexican Cry Mine – 197 (Ref. 176, p. 7). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 213, p.1). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples from the waste pile. Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). For surface waste samples analyzed for metals, samples are compared to the highest background concentrations for each analyte from surface background sample MexCry-SSBG-01-092922 which is the nearest background sample to the AOC (Refs. 196, pp.6,20; 203, pp.6,22). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS (Refs. 194, pp. 6,20; 201, pp.6,22). Ra 226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 194, pp. 6,20; 201, pp.6,22).

Table 61. Sample Description and Analytical Results for AOC 45								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
Background Sample (Background – MexCry BG-01)								
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Arsenic (mg/kg)	0.83 BN	0.96	213, pp.21,22,28,42
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Uranium (mg/kg)	0.41*	0.039	213, pp.21,22,28,42
Upper-limit range of regional background					Radium-226 (pCi/g)	2.23	NA	200, pp. 2,3
AOC Sample(s) (Mexican Cry Mine – 198)								
198-SSW01-01-092822	0-6”	Waste rock sand	596484001	9/28/22	Arsenic (mg/kg)	11.2	0.97	213, pp.16,1555,1556, 1569
198-SSW01-01-092822	0-6”	Waste rock sand	596484001	9/28/22	Uranium (mg/kg)	10.7	0.039	213, pp.16,1555,1556, 1569
198-SSW01-01-092822	0-6”	Waste rock sand	596507001	9/28/22	Radium-226 (pCi/g)	6.16	NA	213, pp.16, 2147, 2148, 2163

* A quality control analyte recovery is outside of the specified acceptance criteria.

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

B Either the analyte was detected in the associated blank or MDL/IDL < sample value < PQL.

N The matrix spike sample recovery is not within the specified control limits.

Number by which this AOC is to be identified: 46

Name of AOC: Hall Mine Waste Pile

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 16

AOC 46 comprises one waste pile: Hall Mine Waste Pile. Hall Mine was operated from 1956 to 1958 by W.B. Hall. While operational, the mine had a total reported ore production volume of 2,448 tons (Ref. 177, p.5). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 213, p.1). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples from the waste pile. Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). For surface waste samples analyzed for metals, samples are compared to the highest background concentrations for each analyte from surface background sample MexCry-SSBG-01-092922 which is the nearest background sample to the AOC (Refs. 196, pp.6,20; 203, pp.6,22). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra 226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 196, pp. 6,20; 203, pp.6,22).

Table 62. Sample Description and Analytical Results for AOC 46

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Background – MexCry BG-01)								
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Arsenic (mg/kg)	0.829 BN	0.96	213, pp. 22, 28, 35
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Uranium (mg/kg)	0.408 *	0.039	213, pp. 22, 28, 35
Upper-limit range of regional background					Radium-226 (pCi/g)	2.23	NA	200, pp. 2,3
AOC Samples – Hall Mine Waste Pile								
468-SSW01-01-092922	0-6”	Waste rock sand	596516003	9/29/22	Arsenic (mg/kg)	17.4 N	1.03	213, pp. 21, 2887, 2904
468-SSW02-01-092922	0-6”	Waste rock sand	596516004	9/29/22	Uranium (mg/kg)	1,380 *	0.412	213, pp. 21, 2887, 2906
468-SSW01-01-092922	0-6”	Waste rock sand	596524003	9/29/22	Radium-226 (pCi/g)	69.5	NA	213, pp. 21, 4088, 4104

* A quality control analyte recovery is outside of the specified acceptance criteria.

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

B Either the analyte was detected in the associated blank or MDL/IDL < sample value < PQL.

N The matrix spike sample recovery is not within the specified control limits.

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 47

Name of AOC: Nakai Chee Begay Waste Pile

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 16

AOC 47 comprises one waste pile: Nakai Chee Begay Waste Pile. Nakai Chee Begay Mine was operated by Marcy Exploration from 1955 to 1956, W.B. Hall from 1956 to 1960, and J.W. Hall in 1956. While operational, the mine had a total reported ore production volume of 399 tons (Ref. 178, p.5). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 213, p.1). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples from the waste pile. Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). For surface waste samples analyzed for metals, samples are compared to the highest background concentrations for each analyte from surface background sample MexCry-SSBG-01-092922 which is the nearest background sample to the AOC (Refs. 196, pp.6,20; 203, pp.6,22). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra 226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 197, pp. 6,27,31; 204, pp.6,30).

Table 63. Sample Description and Analytical Results for AOC 47

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (Background – MexCry BG-01)								
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Arsenic (mg/kg)	0.829 BN	0.96	213, pp. 22, 28, 35
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Uranium (mg/kg)	0.408 *	0.039	213, pp. 22, 28, 35
Upper-limit range of regional background					Radium-226 (pCi/g)	2.23	NA	213, pp. 21, 843, 859
AOC Samples – Nakai Chee Begay Mine Waste Pile								
199-SSW02-01-092922	0-6”	Waste rock sand	596484006	9/29/22	Arsenic (mg/kg)	12.2	0.99	213, pp. 19, 1556, 1579
199-SSW02-	0-6”	Waste rock sand	596484006	9/29/22	Uranium (mg/kg)	38.4	0.039	213, pp. 19, 1556, 1579

Table 63. Sample Description and Analytical Results for AOC 47								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
01-092922								
199-SSW02-01-092922	0-6”	Waste rock sand	596507006	9/29/22	Radium-226 (pCi/g)	23.5	NA	213, pp. 19, 2147, 2168

* A quality control analyte recovery is outside of the specified acceptance criteria.
1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).
2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).
B Either the analyte was detected in the associated blank or MDL/IDL < sample value < PQL.
N The matrix spike sample recovery is not within the specified control limits.
NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 48

Name of AOC: Tom Joe No. 6 Waste Pile

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 16

AOC 48 comprises one waste pile: Tom Joe No. 6 Waste Pile. Tom Joe No. 6 Mine was operated by James W. Hall in 1963. While operational, the mine had a total reported production volume of 29 tons (Ref. 179, p.5). The waste generated is a result of mine operations in ore bodies within the Salt Wash Member of the Lower Morrison Formation (Ref. 213, p.1). Surficial contamination documented in the AOC sample results below shows that the waste pile does not have a continuous cover of 2 feet or greater.

All waste samples are surface samples from the waste pile. Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). For surface waste samples analyzed for metals, samples are compared to the highest background concentrations for each analyte from surface background sample MexCry-SSBG-01-092922 which is the nearest background sample to the AOC (Refs. 196, pp.6,20; 203, pp.6,22). All Ra-226 results for this AOC exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra 226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Refs. 194, pp. 6,32; 202, pp.6,21).

Table 64. Sample Description and Analytical Results for AOC 48								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
Background Sample (Background – MexCry BG-01)								
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Arsenic (mg/kg)	0.829 BN	0.96	213, pp. 22, 28, 35
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Lead (mg/kg)	4.570	0.39	213, pp. 22, 28 ,35
MexCry-SSBG-01-092922	0-6”	Silty sand	596526001	9/29/22	Uranium (mg/kg)	0.408*	0.039	213, pp. 22, 35, 42
Upper-limit range of regional background					Radium-226 (pCi/g)	2.23	NA	200, pp. 2,3
AOC Samples – Tom Joe No. 6 Waste Pile								
427-SSW01-01-092922	0-6”	Waste rock sand	596484007	9/29/22	Arsenic (mg/kg)	22	1.0	213, pp. 19, 1556, 1581
427-SSW01-01-092922	0-6”	Waste rock sand	596484007	9/29/22	Lead (mg/kg)	38.5	0.41	213, pp. 19, 1556, 1581
427-SSW01-01-092922	0-6”	Waste rock sand	596484007	9/29/22	Uranium (mg/kg)	1,480	0.82	213, pp. 19, 1556, 1581
427-SSW01-02-092922	0-6”	Waste rock sand	596524001	9/29/22	Radium-226 (pCi/g)	345	NA	213, pp.20, 4087, 4102

* A quality control analyte recovery is outside of the specified acceptance criteria.

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, pp. 2-47).

B Either the analyte was detected in the associated blank or MDL/IDL < sample value < PQL.

N The matrix spike sample recovery is not within the specified control limits.

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Areas of Observed Contamination 49 to 51 – Cove Transfer Station

The Cove Transfer Station (CTS) area includes three AOCs.

Table 65. Cove Transfer Station AOCs			
AOC No.	**AOC Type**	**Mine/Claim Names**	**RSE Waste Pile Names**
49	Contam. Soil	Cove Day School	Not Applicable
50	Contam. Soil	CTS Residence 1	Not Applicable
51	Pile	Cove Transfer Station 2	CTS2 Stockpile

The transfer stations were mining operation field camps and uranium ore storage and transfer facilities. CTS South is an extension of CTS (Ref. 40, p.28). CTS and CTS South began operation in 1952 when Kerr-McGee began mining operations in the nearby Lukachukai Mountains. Operations associated with CTS ceased by 1968. The former field camp area included miner housing, an administrative structure, and vehicle maintenance facilities (Ref. 40, p.28). The Cove Day School is adjacent to CTS South across Indian Route 33 (Ref. 40, p.23). Ore mined within the Lukachukai Mountains was stockpiled at CTS before it was transported to the Shiprock Mill (Ref. 40, p.28). Two residences are now located within the former CTS area, and one residence meets the definition of a resident individual (Ref. 45, p.27).

In 2012, the USEPA Region 9 Emergency Response Section conducted an interim removal action at CTS and CTS South. Waste material from these two areas was transported to and combined with existing waste at CTS 2 to create a stockpile. Before the removal action, CTS 2 also operated as a transfer facility for mine material from the Lukachukai Mountains (Ref. 44, pp.12,13,26).

One residential property on the CTS AOC meets the definition of a resident individual because a post-removal surface soil sample meeting the observed contamination criteria is on the residential property and within 200 feet of the residence.

BSA-6 and BSA-7 were selected as the most appropriate background locations for AOCs 49, 50, and 51 because they are within the same geologic unit and host similar soil types as those at AOCs (Ref. 43, pp. 45,46,627,731). The highest background concentration for each metals analyte in either BSA-6 or -7 was used as the metals background level for AOCs 49, 50, and 51 (Ref. 43, pp.653,757). The highest Ra-226 mean plus two standard deviations from either BSA-6 or -7 was used as the Ra-226 background level for AOCs 49, 50, and 51 (Ref. 43, pp.650,760).

Number by which this AOC is to be identified: 49

Name of AOC: Cove Day School

AOC Type: Contaminated Soil

Location and description of AOC (with reference to a map of the area): Figure 17

AOC 49 comprises three contaminated soil samples collected from the Cove Day School property in 2022 and located within 200 feet of regularly used school buildings and playgrounds. Soil contamination is not inferred between sample locations since there are paved areas and the deposition is likely not widespread as confirmed by area-wide gamma scanning. The Cove Day School is approximately 50 feet from the CTS South removal action

excavation zone (Ref. 44, pp.10,26). The Cove Day School was in operation during the time that mining occurred, and portions of the school property were used by ore haul trucks as a waiting area while other trucks unloaded at the transfer station across the street. Ore rocks were unique on an otherwise sandy schoolyard, so they may also have been moved around by children or others over the years.

In 2018, the Bureau of Indian Education investigated radiation levels in soil at the Cove Day School in preparation for the future construction of a new school. Gamma scanning of the schoolyard identified five areas of elevated gamma radiation with background levels in between (Ref. 74, pp.12-18,20). In 2022, USEPA collected four samples of what appeared to be ore rocks from these elevated gamma areas; three of these samples were greater than three times the background concentrations (Ref. 73, pp. 8,9).

Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). All samples are surface soil samples from on the school property. Surface soil samples analyzed for metals are compared to the highest background concentrations for each analyte from surface background samples within an unimpacted background area near the AOC (Refs. 40, p.37; 43, pp.650,754). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

Soil samples comprising this AOC are impacted by mineralized rock, characteristic of ore from the Lukachukai Mountains (Ref. 73, pp. 42, 44, 45). No natural sources of this mineralized rock are present in the Cove Valley where the school is located (Ref. 43, pp. 630,633,634,734,737,738). Over decades since the mineralized ore rock was deposited in the school yard, natural and anthropogenic break-down of the rock resulted in soils around the rock becoming contaminated and taking on soil characteristics dissimilar from native soils. Therefore, background soil samples from BSA-6 and BSA-7 are expected to differ from contaminated soils on the school yard because of the deterioration of non-native ore rock at AOC sample locations. The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 174, p.22).

Table 66. Sample Description and Analytical Results for AOC 49

Sample ID	Sample Depth	Soil Type	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[1]	Reference
Background Sample (BSA 6)								40, p.37; 43, p.650
B6-SS07-01-052218	0-6”	Sandy loam	1805582-8	5/22/18	Lead (mg/kg)	14	0.2	43, p. 6825; 141, pp. 5, 33; 220, p. 72
Background Sample (BSA 7)								40, p.37; 43, p.754
B7-SS19-01-052218	0-6”	Sandy loam	1805587-7	5/22/18	Uranium (mg/kg)	1.7	0.011	43, p.6834; 142, pp.5,31; 220, p.97
BSA-7	0-6”	Sandy loam	1805586	5/22/18	Radium-226 (pCi/g)	2.49*	NA	43, p.6834;

Table 66. Sample Description and Analytical Results for AOC 49								
Sample ID	**Sample Depth**	**Soil Type**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[1]**	**Reference**
								200, p.1; 142, p.9; 220, p.90
AOC Samples – Cove Day School Contaminated Soil								
472-SSW06-01-072022	0-3”	Mineralized ore rock soil	2207534-7	7/20/22	Lead (mg/kg)	710	200	73, p. 42; 174, pp. 4, 21
472-SSW06-01-072022	0-3”	Mineralized ore rock soil	2207534-7	7/20/22	Uranium (mg/kg)	31,000	20	73, p. 42; 174, pp. 4, 21
472-SSW06-01-072022	0-3”	Mineralized ore rock soil	2207535-7	7/20/22	Radium-226 (pCi/g)	2,230 (22,300 J, M3,G)	NA	73, p. 42; 184, pp. 6,30
472-SSW10-01-072022	0-3”	Mineralized ore rock soil	2207534-11	7/20/22	Lead (mg/kg)	43	0.2	73, p. 44; 174, pp. 4, 29
472-SSW10-01-072022	0-3”	Mineralized ore rock soil	2207534-11	7/20/22	Uranium (mg/kg)	2,400	2	73, p. 44; 174, pp. 4, 29
472-SSW10-01-072022	0-3”	Mineralized ore rock soil	2207535-11	7/20/22	Radium-226 (pCi/g)	1,060 M3	NA	73, p. 44; 184, pp. 6, 38;
472-SSW12-01-072022	0-3”	Mineralized ore rock soil	2207534-13	7/20/22	Uranium (mg/kg)	6,600	2	73, p. 45; 174, p.4,33
472-SSW12-01-072022	0-3”	Mineralized ore rock soil	2207535-13	7/20/22	Radium-226 (pCi/g)	3,770 M3	NA	73, p. 45; 184, p.6,44

1 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

G Sample density differs by more than 15% of laboratory control sample density.

J The analyte was detected at the reported concentration; the quantitation is an estimate. As a result, the concentration of this qualified data has been adjusted (Ref. 48, p.7, 8).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC.

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 50

Name of AOC: Cove Transfer Station – Residence 1

AOC Type: Contaminated Soil

Location and description of AOC (with reference to a map of the area): Figure 17

AOC 50 comprises an area of residual contaminated soil on residential lease land and within 200 feet of a residence. Residence 1 is located on the north portion of CTS, and the homesite lease area is approximately 1,600 square feet (Ref. 44, p.72). An unpaved road for residence access is located east of the property. To the west of CTS is Indian Route 33 (Refs. 44, p.71; 45, p.9).

Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). All samples are surface soil samples from Residence 1, and sample 472-SSW04-01-072022 is located within 200 feet of the residential structure. For surface soil samples analyzed for metals, soil samples are compared to the highest background concentrations for each analyte from surface background samples near the AOC (Refs. 40, p.37; 43, p.754). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174).

Soil samples comprising this AOC are impacted by mineralized rock, characteristic of ore from the Lukachukai Mountains (Ref. 73, pp. 42,44,45,2153). No natural sources of this mineralized rock are present in the Cove Valley where Residence 1 is located (Ref. 43, pp. 630,633,634,734,737,738). Over decades since the mineralized ore rock was deposited at the Cove Transfer Station (location of Residence 1), natural and anthropogenic break-down of the rock resulted in soils around the rock becoming contaminated and taking on soil characteristics dissimilar from native soils. Therefore, background soil samples from BSA-6 and BSA-7 are expected to differ from contaminated soils on Residence 1 because of the deterioration of non-native ore rock at AOC sample locations. The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 174, p.18).

Table 67. Sample Description and Analytical Results for AOC 50

Sample ID	Sample Depth	Soil Type	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[1]	Reference
Background Sample (BSA 7)								40, p.37; 43, p.754
B7-SS19-01-052218	0-6”	Sandy loam	1805587-7	5/22/18	Uranium (mg/kg)	1.7	0.011	43, p.6834; 142, pp. 5, 31; 220, p. 97

BSA-7	0-6”	Sandy loam	1805586	5/22/18	Radium-226 (pCi/g)	2.49*	NA	43, p.6834; 200, p.1; 142, p.9; 220, p.90
AOC Sample – CTS/TS1 Residence 1 Contaminated Soil								
472-SSW04-01-072022	0-3”	Mineralized ore rock soil	2207534-5	7/20/22	Uranium (mg/kg)	10 (100 J)	0.021	73, p. 2153; 174, pp. 4, 17
472-SSW04-01-072022	0-3”	Mineralized ore rock soil	2207535-5	7/20/22	Radium-226 (pCi/g)	116 M3	NA	73, p. 2153; 184, pp. 6, 26;
T9-XS61-01-042518	0-3”	Waste rock sand	1805036-18	4/25/18	Uranium (mg/kg)	13	0.0097	139, pp. 5, 52;
T9-XS93-01-042518	0-3”	Waste rock sand	1805036-20	4/25/18	Uranium (mg/kg)	11	0.01	139, pp.5,56;

1 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

J The analyte was detected at the reported concentration; the quantitation is an estimate. As a result, the concentration of this qualified data has been adjusted (Ref. 48, p.7, 8).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC.

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

Number by which this AOC is to be identified: 51

Name of AOC: Cove Transfer Station 2 Stockpile

AOC Type: Pile

Location and description of AOC (with reference to a map of the area): Figure 17

AOC 51 is located west of Indian Route 33 and 2.2 miles north of the Cove Day School (Ref. 44, p.71). CTS 2 was used as a stockpile for the waste removed from CTS, CTS South, and CTS 2 as part of the removal action in 2012 (Ref. 44, p.12). In 2012, excavated material from CTS and CTS South was transported and combined with material at CTS 2 to create an aboveground stockpile (Ref. 44, p.29).

Observed contamination is established by analytical significance as compared to background levels (Ref. 1, p.14). All waste samples are surface samples from the waste pile. For waste samples analyzed for metals, samples are

compared to the highest background concentrations for each analyte from surface background samples near the AOC (Refs. 40, p.37; 43, pp.650,754). For Ra-226, observed contamination is established when the Ra-226 concentration is two standard deviations above the mean site-specific Ra-226 background concentration (Refs. 1, pp.14,116; 200, pp. 1-2; 222, pp.171-174). All Ra-226 results for this AOC also exceed the upper-limit range of regional background of 2.23 pCi/g. (Refs. 1, pp.14,116; 200, pp. 2,3; 221, p.25; 222, pp.171-174). The metals analysis was performed by ALS Environmental Laboratories using USEPA method SW-846 6020A ICP-MS. Ra-226 analysis was performed by ALS Environmental Laboratories using USEPA method 901.1 gamma spectroscopy (Ref. 174, p.10,16).

Table 68. Sample Description and Analytical Results for AOC 51

Sample ID	Sample Depth	Soil Type[1]	Laboratory Sample ID	Date	Hazardous Substance	Hazardous Substance Conc.	Reporting Limit[2]	Reference
Background Sample (BSA 7)								40, p.37; 43, p.754
B7-SS19-01-052218	0-6”	Sandy loam	1805587-7	5/22/18	Arsenic (mg/kg)	2	0.21	43, p. 6834; 142 pp. 5, 31; 220, p. 95
B7-SS19-01-052218	0-6”	Sandy loam	1805587-7	5/22/18	Uranium (mg/kg)	1.7	0.011	43, p. 6834; 142, pp. 5,3 1; 220, p. 95
BSA-7	0-6”	Sandy loam	1805586	5/22/18	Radium-226 (pCi/g)	2.49*	NA	43, p.6834; 200, p.1; 142, p.9; 220, p.90
Background Sample (BSA 6)								40, p.37; 43, p.650
B6-SS07-01-052218	0-6”	Sandy loam	1805582-8	5/22/18	Lead	14	0.2	43, p.6825; 141, pp.5,33; 220, p.70
AOC Samples – Cove Transfer Stations 2 Stockpile								
472-SSW03-01-071822	0-3”	Ore rock sand	2207534-4	7/18/22	Arsenic (mg/kg)	6.3	0.2	174, pp. 4, 15
472-SSW03-01-071822	0-3”	Ore rock sand	2207534-4	7/18/22	Uranium (mg/kg)	2,400	2	174, pp. 4, 15;
472-SSW03-01-071822	0-3”	Ore rock sand	2207535-4	7/18/22	Radium-226 (pCi/g)	597 M3	NA	184, pp.6,24;

Table 68. Sample Description and Analytical Results for AOC 51								
Sample ID	**Sample Depth**	**Soil Type[1]**	**Laboratory Sample ID**	**Date**	**Hazardous Substance**	**Hazardous Substance Conc.**	**Reporting Limit[2]**	**Reference**
472-SSW01-01-071822	0-3”	Ore rock sand	2207534-1	7/18/22	Lead (mg/kg)	54	0.2	174, pp. 4, 9;
472-SSW01-01-071822	0-3”	Ore rock sand	2207534-1	7/18/22	Uranium (mg/kg)	4,600	2	174, pp. 4, 9;
472-SSW01-01-071822	0-3”	Ore rock sand	2207535-1	7/18/22	Radium-226 (pCi/g)	1,010 M3	NA	184, pp. 6, 18;
472-SSW02-01-071822	0-3”	Sandy loam	2207534-2	7/18/22	Uranium (mg/kg)	8.3 (83 J)	0.021	174, pp.4,11;
472-SSW02-01-071822	0-3”	Sandy loam	2207535-2	7/18/22	Radium-226 (pCi/g)	62.1	NA	184, pp.6,20;

1 Waste samples from the mine waste piles are compared to soil near the site to establish observed contamination criteria and may differ somewhat than the background soil type (Ref. 211, p. 4).

2 The reporting limit is equivalent to the sample quantitation limit as defined by HRS, Section 1.1., Definitions. (Refs. 1, Section 1.1.; 25, p. 2-47).

* This value represents the concentration that is two standard deviations above the mean for radium-226 samples from the background study area (Ref. 200).

J The analyte was detected at the reported concentration; the quantitation is an estimate. As a result, the concentration of this qualified data has been adjusted (Ref. 48, p.7, 8).

M3 The requested minimum detectable concentration (MDC) was not met, but the reported activity is greater than the reported MDC. Data are usable as is because the result is above the MDC.

NA Reporting limit is not required for determining observed contamination for naturally occurring radionuclides (Ref. 1, pp.116).

AOC Hazardous Waste Quantity

- Hazardous Constituent Quantity:

The hazardous constituent quantity for the AOCs could not be adequately determined according to the HRS requirements; that is, the total mass of all Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances in the AOCs is not known and cannot be estimated with reasonable confidence (Ref. 1, Section 2.4.2.1.1). Contaminant concentrations are not uniform throughout the AOCs and insufficient historical and current data (manifests, potentially responsible party [PRP] records, state records, permits, waste concentration data, etc.) are available to adequately calculate the total or partial mass of all CERCLA hazardous substances associated with the AOCs. Therefore, there is insufficient information to

calculate a total or partial hazardous constituent quantity for the AOCs with reasonable confidence. Scoring proceeds to the evaluation of Tier B, hazardous waste stream quantity (Ref. 1, Section 2.4.2.1.1).

Hazardous Constituent Quantity Assigned Value: Not Scored

Hazardous Constituent Quantity Complete? No

- Hazardous Wastestream Quantity:

The total hazardous wastestream quantity for the AOCs could not be adequately determined according to the HRS requirements; that is, the total mass of all hazardous wastestreams and CERCLA pollutants and contaminants in the AOCs is not known and cannot be estimated with reasonable confidence (Ref. 1, Section 2.4.2.1.2). Contaminant concentrations are not uniform throughout the AOCs and insufficient historical and current data (manifests, PRP records, State records, permits, waste concentration data, annual reports, etc.) are available to adequately calculate the total mass of all hazardous wastestreams and CERCLA pollutants and contaminants in the AOCs. Therefore, there is insufficient information to adequately calculate the total or partial mass of the wastestream in the AOCs. Therefore, there is insufficient information to evaluate the hazardous wastestream quantity for the AOCs with reasonable confidence. Scoring proceeds to the evaluation of Tier C, Volume (Ref. 1, Section 2.4.2.1.2, Table 5-2).

Hazardous Wastestream Quantity Assigned Value: Not Scored

Hazardous Wastestream Quantity Complete? No

- Volume:

Description

The volume measure cannot be used for AOC types Contaminated Soil or Waste Pile (Ref. 1, Section 5.1.1.2.2, Table 5-2).

Equation for Assigning Value (Ref. 1, Table 5-2): Not Determined

Volume Assigned Value: 0

- Area:

The RSE Work Plan and report for the Northern Agency Tronox Mines investigation provide descriptions of the process for mapping the aerial extent of technically enhanced naturally occurring radioactive material (TENORM) features at the LMMD, including the waste piles scored as AOCs (Refs. 62, pp. 68,69; 221, pp. 96,97). The process involved mapping and inventory of mining- or reclamation-related impacts including all waste piles and burial cells (Refs. 62, pp. 68,69; 221, pp. 96,97). Mapping consisted of confirming and recording geospatial locations and areas of waste piles and burial cells by use of handheld Trimble Geo 7XH Global Positioning System (GPS) units with sub-foot accuracy after postprocessing. Results were recorded in a geodatabase of features and reported in maps within mine specific RSE Reports (Ref. 62, pp. 68,69). Boundaries of waste piles and burial cells were refined using data from a baseline analysis of light detection and ranging (LiDAR) data and other aerial extent data sources (Ref. 62, p. 56). Surface extent of waste piles and burial cells were captured in the geodatabase and are presented in the AOC measurements in the table below (Refs. 62, pp. 68,69; 221, pp. 96,97). Below is a summary of the areas and calculated assigned values for each AOC with source type “pile”. Per HRS Table 5-2 the area of a pile in square feet is divided by 34 to obtain its assigned value.

Table 69. Summary of Area Values for Pile AOCs					
AOC No.	**Waste Description**	**Source Type**	**Area (ft^2)**	**Assigned Value***	**References**
1	Mesa I Mine 10 Waste Pile M3	Pile	17,468	513.77	3, pp.132,133
2	Mesa I Mine 11 Waste Pile M4	Pile	49,206	1,447.24	4, pp.133,134
	Mesa I Mine 11 Burial Cell 9	Pile	16,393	482.14	4, pp.133, 134
3	Mesa I Mine 12 Waste Pile M5A	Pile	24,524	721.30	5, pp.135,136
	Mesa I Mine 12 Waste Pile M5B	Pile	85,255	2,507.51	5, pp.135,136
	Mesa I Mine 12 Waste Pile M5C	Pile	14,801	435.31	5, pp.135,136
4	Mesa I Mine 13 Waste Pile M6	Pile	103,598	3,047.01	6, pp.132,133
5	Mesa I Mine 14 Waste Pile M7A	Pile	40,577	1,193.43	7, pp.134-136
	Mesa I Mine 14 Waste Pile M7B	Pile	43,705	1,285.45	7, pp.134-136
	Mesa I Mine 14 Waste Pile M7C	Pile	3,807	111.97	7, pp.134-136
6	Mesa I Mine 15 Waste Pile M8A	Pile	998	1,657.09	8, pp.134-136
	Mesa I Mine 15 Waste Pile M8B	Pile	56,341	29.35	8, pp.134-136
	Mesa I Mine 15 Burial Cell 6a	Pile	2,939	86.45	8, pp.134-136
	Mesa I Mine 15 Burial Cell 6b	Pile	1,068	31.41	8, pp.134-136
	Mesa I Mine 15 Burial Cell 7	Pile	933	27.44	8, pp.134-136
7	Mesa I Camp Burial Cell 310AB	Pile	34,577	1,016.98	41, pp.132,133
	Mesa I Camp Waste Pile T17A	Pile	3,172	93.29	41, pp.132,133
	Mesa I Camp Waste Pile T17B	Pile	1,033	30.38	41, pp.132,133
8	Mesa I 1/4 Mine Waste Pile M9	Pile	33,082	972.99	9, pp.128,129
9	Mesa I 1/2 Mine Waste Pile M10A	Pile	37,684	1,108.35	10, pp.127,128
	Mesa I 1/2 Mine Waste Pile M10B	Pile	2,364	69.52	10, pp.127,128
10	Mesa I 1/2 West Mine Waste Pile M12	Pile	5,420	159.41	12, pp.126,127
11	Mesa I 3/4 Incline Waste Pile M25	Pile	10,660	313.53	25, pp.131,132
	Mesa I 3/4 Incline Burial Cell 31a	Pile	1,420	41.77	25, pp.131,132
	Mesa I 3/4 Incline Burial Cell 31b	Pile	11,153	328.03	
12	Mesa II, Mine No. 1, P-150 Waste Pile M28	Pile	39,028	1,147.87	28, pp.128,129
	Mesa II, Mine No. 1 & 2, P-21 Waste Pile M27	Pile	19,752	580.93	27, pp.132,133
	Mesa II, Mine No. 1 & 2, P-21 Burial Cell 39	Pile	75,147	2,210.20	27, pp.132,133
	Mesa I 3/4, Mine No. 2, P150		Unknown but >0	>0	
13	Mesa II, Mine 4 Waste Pile M29A	Pile	12,796	376.34	29, pp.127,128
	Mesa II, Mine 4 Waste Pile M29B	Pile	5,432	159.75	29, pp.127,128
	Mesa II, Mine 4 Burial Cell 43	Pile	4,203	123.63	29, pp.127,128
14	Mesa II Pit Waste Pile M24	Pile	73,721	2,168.25	24, pp.131,132
	Mesa II Pit Burial Cell 44	Pile	2,951	86.81	24, pp.131,132
15	Mesa II 1/4 Mine Waste Pile CO-07_NNWP01	Pile	871	25.62	82, pp.23,38
	Mesa II 1/4 Mine Waste Pile CO-07_NNWP02	Pile	871	25.62	82, pp.23,38
16	Henry Phillips Mine Waste Pile M11	Pile	29,364	863.63	11, pp.125,126
17	Billy Topaha Mine Waste Pile CO-03_CAWP01	Pile	436	12.82	83, pp.23,41

Table 69. Summary of Area Values for Pile AOCs					
AOC No.	**Waste Description**	**Source Type**	**Area (ft^2)**	**Assigned Value***	**References**
18	Mesa II 1/2 Mine 10 Waste Pile M30	Pile	56,832	1,671.53	30, pp.131,132
	Mesa II 1/2 Mine 10 Burial Cell 48	Pile	9,965	293.08	30, pp.131,132
19	Mesa II 1/2 Mine 4 Waste Pile M31	Pile	9,367	275.50	31, pp.131,132
	Mesa III Mine Waste Pile M32	Pile	33,950	998.53	32, pp.133,134
20	Mesa III, Northwest Mine Waste Pile CO-08-CAWP01	Pile	3,920	115.29	80, pp.21,36
21	Mesa III, West Mine Waste Pile CO-09-NNWP01	Pile	11,906	350.18	81, pp.21,39
22	Mesa IV, Mine No. 1 Waste Pile M20A	Pile	72,712	2,138.60	20, pp.134-136
	Mesa IV, Mine No. 1 Burial Cell 56	Pile	16,075	472.78	20, pp.134-136
	Mesa IV, Mine No. 1 Waste Pile M20B	Pile	47,492	1,396.82	20, pp.134-136
	Mesa IV, Mine No. 3 Waste Pile M22A	Pile	17,141	504.15	22, pp.128, 129
	Mesa IV, Mine No. 3 Waste Pile M22B	Pile	7,785	228.97	22, pp.128, 129
	Mesa IV, Mine No. 3 Waste Pile M22C	Pile	13,436	395.16	22, pp.128, 129
23	Mesa IV, Mine No. 2 Waste Pile M21A	Pile	16,872	496.25	21, pp.134-136
	Mesa IV, Mine No. 2 Waste Pile M21B	Pile	9,636	283.41	21, pp.134-136
	Mesa IV, Mine No. 2 Waste Pile M21C	Pile	2,666	78.41	21, pp.134-136
	Mesa IV, Mine No. 2 Waste Pile M21D	Pile	14,718	432.89	21, pp.134-136
	Mesa IV, Mine No. 2 Waste Pile M21E	Pile	2,515	73.96	21, pp.134-136
	Mesa IV, Mine No. 2 Waste Pile M21F	Pile	54,050	1,589.70	21, pp.134-136
	Mesa IV, Mine No. 2 Burial Cell 63	Pile	14,490	426.18	21, pp.134-136
24	Mesa IV, West Mine Waste Pile M23	Pile	19,549	574.98	23, pp.130, 131
	Mesa IV, West Mine Burial Cell 70b	Pile	2,033	59.78	23, pp.130, 131
25	Mesa IV 1/4 Mine Waste Pile CO-10_NNWP01	Pile	14,593	429.21	79, pp.21, 38
26	South Portal Frank No. 1 Mine Waste Pile CO-05_NNWP14	Pile	10,237	301.09	76, pp.43,86
	South Portal Frank No. 1 Mine Waste Pile CO-05_NNWP15	Pile	10,237	301.09	76, pp.43,86
	South Portal Frank No. 1 Mine Waste Pile CO-05_NNWP16	Pile	10,237	301.09	76, pp.43,86

Table 69. Summary of Area Values for Pile AOCs					
AOC No.	**Waste Description**	**Source Type**	**Area (ft^2)**	**Assigned Value***	**References**
	South Portal Frank No. 1 Mine Waste Pile CO-05-NNWP18	Pile	29,621	871.21	76, pp.43,86
	South Portal Frank No. 1 Mine Waste Pile CO-05_NNWP17 and Waste Pile CO-05_NNWP19	Pile	13,649	401.44	76, pp.43,86
	East Portal Frank No. 1 Mine Waste Pile CO-05_NNWP05	Pile	2,287	67.26	76, pp.42,85
	East Portal Frank No. 1 Mine Waste Pile CO-05_NNWP06, Waste Pile CO-05_NNWP08, Waste Pile CO-05_NNWP09, and Waste Pile CO-05_NNWP10	Pile	47,481	1,396.50	76, pp.42,85
	East Portal Frank No. 1 Mine Waste Pile CO-05_NNWP07 and Waste Pile CO-05_NNWP11	Pile	15,173	446.26	76, pp.42,85
	East Portal Frank No. 1 Mine Waste Pile CO-05_NNWP12	Pile	3,287	96.68	76, pp.42,85
	East Portal Frank No. 1 Mine Waste Pile CO-05_NNWP13	Pile	9,148	269.06	76, pp.42,85
	North Portal Frank No. 1 Mine Waste Pile CO-05_NNWP01 and Waste Pile CO-05_NNWP04	Pile	10,019	294.68	76, pp.41,84
	North Portal Frank No. 1 Mine Waste Pile CO-05_NNWP02	Pile	6,098	179.35	76, pp.41,84
	North Portal Frank No. 1 Mine Waste Pile CO-05_NNWP03	Pile	11,543	339.50	76, pp.41,84
	Frank No. 2 Mine Waste Pile CO-06_NNWP01	Pile	9,583	281.85	77, pp.23,37
	Mesa IV 1/2 Mine and Simpson 181 Waste Pile M19	Pile	22,268	654.96	19, pp.131, 132
	Mesa IV 1/2 Mine and Simpson 181 Burial Cell 86b	Pile	8,104	238.37	19, pp.131, 132
	Mesa V Mine – 508 Waste Pile M18	Pile	6,144	180.72	18, pp.130, 131
	Mesa V Mine – 508 Burial Cell 87a	Pile	14,261	419.43	18, pp.130, 131
27	NA-0316 Waste Pile CO-11_NNWP01	Pile	2,614	76.88	78, pp.24,38
	NA-0316 Waste Pile CO-11_NNWP02	Pile	20,582	605.35	78, pp.24,38
	NA-0316 Waste Pile CO-11_NNWP03	Pile	7,696	226.35	78, pp.24,38
28	Mesa IV, Cov087	Pile	Unknown but >0	0	
29	Mesa V Mine – 103 Waste Pile M17	Pile	62,898	1,849.95	17, pp.141,142
	Mesa V Adit Waste Pile M16A	Pile	45,916	1,350.47	16, pp.131,132
	Mesa V Adit Burial Cell 91	Pile	2,789	82.03	16, pp.131,132
	Mesa V Adit Waste Pile M16B	Pile	29,374	863.95	16, pp.131,132
	Mesa V Adit Burial Cell 92	Pile	1,570	46.17	16, pp.131,132
	Mesa V Adit Burial Cell 93	Pile	10,014	294.54	16, pp.131,132

Table 69. Summary of Area Values for Pile AOCs					
AOC No.	**Waste Description**	**Source Type**	**Area (ft^2)**	**Assigned Value***	**References**
	NA-0344B Burial Cell 344B-2	Pile	3,763	110.67	42, pp.127,128
	Mesa V Incline Waste Pile M15A	Pile	19,568	575.54	15, pp.128,129
	Mesa V Incline Waste Pile M15B	Pile	6,978	205.24	15, pp.128,129
30	Mesa VI Mine Waste Pile M13A	Pile	35,329	1,039.10	13, pp.128,129
	Mesa VI Mine Waste Pile M13B	Pile	10,208	300.23	13, pp.128,129
31	Cato No. 2 CO-04-NNWP01	Pile	30,492	896.82	75, pp.23,41
32	Frank Jr. Mine Waste Pile M14	Pile	49,609	1,459.08	14, pp.128,129
33	Knife Edge Mesa Mine Waste Pile M33	Pile	2,750	80.88	33, pp.127,128
34	Camp Mine Waste Pile M52	Pile	55,709	1,638.51	186, pp. 5,6
35	Cisco Mine Waste Piles M53A	Pile	37,519	1,103.51	186, pp. 5,6
	Cisco Mine Waste Piles M53B	Pile	11,720	344.71	186, pp. 5,6
36	Joleo Mine Waste Pile M54	Pile	81,945	2,410.16	186, pp. 5,6
37	Flag No. 1 Mine Waste Pile M37A	Pile	31,447	924.92	37, pp.128,129
	Flag No. 1 Mine Waste Pile M37B	Pile	10,633	312.72	37, pp.128,129
38	Black No. 1 Mine Waste Pile M34A	Pile	20,718	609.34	34, pp.128,129
	Black No. 1 Mine Waste Pile M34B	Pile	11,556	339.87	34, pp.128,129
39	Black No. 2 Mine Waste Pile M35A	Pile	2,005	58.97	35, pp.127,128
	Black No. 2 Mine Waste Pile M35B	Pile	1,780	52.37	
	Black No. 2 Mine Waste Pile M35C	Pile	2,218	65.24	
	Black No. 2 Mine, West Waste Pile M36	Pile	7,570	222.65	36, pp.127,128
40	Step Mesa Mine Waste Pile M38	Pile	5,081	149.44	38, pp.129,130
41	Jimmie King No. 9 Mine Waste Pile	Pile	Unknown but >0	>0	
42	NA-0332 Waste Pile	Pile	Unknown but >0	>0	
43	NA-0333 Waste Pile	Pile	Unknown but >0	>0	
44	Mexican Cry Mine – 197 Waste Pile	Pile	Unknown but >0	>0	
45	Mexican Cry Mine – 198 Waste Pile	Pile	Unknown but >0	>0	
46	Hall Mine Waste Pile	Pile	Unknown but >0	>0	
47	Nakai Chee Begay Mine Waste Pile	Pile	Unknown but >0	>0	
48	Tom Joe No. 6 Waste Pile	Pile	Unknown but >0	>0	
51	Cove Transfer Station 2 Stockpile	Pile	280,781	8,258.26	Ref. 44, p.24
	Sum (Pile)		**>2,460,662**	**>72,372.41**	

* Assigned Value is the Area in square feet divided by 34 (Ref. 1, p.80, Table 5-2)

Per the HRS, the highest of the values assigned to each area of observed contamination for hazardous constituent quantity (Tier A), hazardous wastestream quantity (Tier B), Volume (Tier C), and Area (Tier D) should be assigned as that area of observed contamination's hazardous waste quantity value (Ref. 1, Section 2.4.2.1.5). These assigned hazardous waste quantity values are based on the non-radioactive hazardous substances only and do not include the radioactive substance (radium-226). There is insufficient information to score the radioactive hazardous waste quantity values, therefore it is unknown but >0 (Ref. 1, Section 7.2.5.3, Table 2-6).

Below is a summary of the areas and calculated assigned hazardous waste quantity values for each AOC with source type "contaminated soil". Per HRS Table 5-2 the area of contaminated soil in square feet is divided by 34,000 to obtain its assigned value.

Table 70. Summary of Area Values for Contaminated Soil AOCs					
AOC No.	**Waste Description**	**Source Type**	**Area (ft^2)**	**Assigned Value**	**References**
49	Cove Day School	Contaminated Soil	Unknown but >0	>0	
50	Cove Transfer Station	Contaminated Soil	Unknown but >0	>0	
	Sum (Contaminated Soil)			**>0**	

The sum of all AOC hazardous waste quantity assigned values is >72,372.41; this sum is used to determine the hazardous waste quantity factor value for the pathway (Ref. 1, Section 2.4.2.2, Table 2-6).

Hazardous Waste Quantity Factor Value (Ref. 1, Table 2-6): 10,000

Attribution

The LMMD site is the result of a post-World War II and Cold War uranium and vanadium mining district operated by a series of mining companies under numerous mine claims and leases between 1949 and 1968 (Ref. 187, pp. 34-53). The LMMD site comprises 51 AOCs; 49 of which are waste piles and 2 consist of contaminated soil. Each AOC is the direct result of uranium and vanadium ore extraction, transport, transfer, storage, and/or migration derived from mining activities in the Lukachukai Mountains (Refs. 187, p. 5; 210). The waste is the byproduct of mine operations in ore deposits within the Salt Wash Member of the Lower Morrison Formation (see section 5.1.0 of this HRS documentation record). While natural in origin, the waste materials are present and exposed at the ground surface due to mining activities.

The dominant mining methods in LMMD consisted of underground room and pillar, open stoping, incline shafts, and vertical shafts, resulting in waste piles comprising remnant overburden, protore, and other contaminated material (Refs. 19, p. 3; 187, p. 14, 15). The waste piles were created from the mining operation that extracted uranium ore (Ref. 210). Numerous samples collected from the waste piles, which are present throughout the LMMD site, have been shown to contain arsenic, lead, vanadium, and radium-226 at concentrations significantly greater than background levels (see Figures 1-19 and section 5.1.0 of this HRS documentation record).

Lead, uranium, and radium-226 were also detected at concentrations significantly above background levels in surface soils at the Cove Day School, and uranium and radium-226 were detected at concentrations significantly above background levels in surface soil at a residential property (see section 5.1.0 of this HRS documentation record). Ore mined within the Lukachukai Mountains was stockpiled at the Cove transfer station before it was transported to the Shiprock Mill (Ref. 40, p.28). The transfer stations were mining operation field camps and uranium ore storage and transfer facilities (ref. 210, pp.1,2,4). The Cove Day School is adjacent to CTS South, and the residential property is now located within the former CTS area. The Cove Day School was in operation during the time that the mining operations occurred, and portions of the school property were used by ore haul trucks as a waiting area, likely resulting in the soil contamination, while other trucks unloaded at the transfer station across the street. Ore rocks were unique on an otherwise sandy schoolyard, so they may also have been moved around by children or others over the years. There are no nearby natural sources of the uranium ore material found in the schoolyard, as the Salt Wash Member of the Lower Morrison Formation is only present in the Lukachukai Mountains (Ref. 189, pp.10,17,18).

No other anthropogenic origins of the hazardous substances have been identified in the area.

Hazardous Substances in the Release

Arsenic
Lead
Ra-226
Uranium

Additional hazardous substances met the AOC criteria; however, they were not included in this HRS documentation record since the analytes did not increase the overall HRS score of the LMMD site (Ref. 62, pp.141,142).

Other Possible Areas of Observed Contamination

Fourteen other possible areas of observed contamination are located on Cove Mesa, East Mesa, and West Mesa. Twelve are on Cove Mesa, one is on East Mesa, and one is on West Mesa. (Ref. 214, pp. 1-9). West Mesa Mine is in the Round Rock Chapter, and East Mesa Mine is in the Red Valley Chapter. The Cove Mesa mines are split between the Sweetwater/Tolikan Chapter and Red Valley Chapter since the chapter border runs down the middle of the mesa. Mines on the east side of Cove Mesa are generally in the Red Valley Chapter while mines on the west side of Cove Mesa are in the Sweetwater/Tolikan Chapter (Ref. 57, p.2). Each of these other possible areas of observed contamination has been sampled and found to be contaminated with the same contaminants as the scored AOCs (see Figures 18 and 19).

Cove Mesa Mines (Cato Sells) were operated by Cato Sells under VCA from 1950 through 1965 (Ref. 56, p.10). Cove Mesa Mines (AEC Plot 7) were operated by VCA, Leroy Pettigrew, and William Wittmeyer from 1954 through 1961 and by VCA, C.H. Corey Jr., and William George from 1966 through 1965 (Refs. 59, p.22; 175, p. 3). East Mesa Mines were operated by Leroy Pettigrew from 1951 through 1953 and by Pettigrew and Davis from 1953 through 1955 (Ref. 58, p.5). The operator of West Mesa Mine is unknown (Ref. 57, p.5). Operations included underground mining that tapped paleochannels in the Salt Wash Member of the Lower Morrison Formation that are rich in uranium and vanadium. Underground mine workings exist within the Cove Mesa area. Waste piles consist of overburden or lower grade protore discarded near or downslope of portals (Refs. 56, pp.7,8,9; 57, p.4; 58, p.4; 59, pp.13,15,16,18,19, 20,21).

Table 71. Summary of Other Possible AOCs

Other Possible AOC Names	Other Possible Areas of Observed Contamination Description (Reference)
1. Cove Mesa Mines (Cato Sells – 34)	Cove Mesa Mines (Cato Sells) are located north of Cove Mesa Mines (AEC Plot 7) (Figure 18) (Ref. 56, p.2). Sample 034-SSW01-01-100322 collected within the first 6 inches of the surface at Cato Sells – 34 mine has concentrations of uranium at 500 milligrams per kilogram (mg/kg) and Ra-226 at 177 picocuries per gram (pCi/g) (Refs. 196, p.38; 203, p.31). Background sample COVE-SSBG02-01-100322 has concentrations of arsenic at 0.96 mg/kg, lead at 4.1 mg/kg, uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
2. Cove Mesa Mines (Cato Sells – 35)	Cove Mesa Mines (Cato Sells) are located north of Cove Mesa Mines (AEC Plot 7) (Figure 18) (Ref. 56, p.2). Sample 035-SSW01-01-100322 collected within the first 6 inches of the surface at Cato Sells – 35 mine has concentrations of arsenic at 6.3 mg/kg, uranium at 975 mg/kg, and Ra-226 at 201 pCi/g (Refs. 196, p.34; 203, p.29). Background sample

Table 71. Summary of Other Possible AOCs	
Other Possible AOC Names	**Other Possible Areas of Observed Contamination Description (Reference)**
	COVE-SSBG02-01-100322 has concentrations of arsenic at 0.96 mg/kg, lead at 4.1 mg/kg, uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
3. Cove Mesa Mines (Cato Sells – 36)	Cove Mesa Mines (Cato Sells) are located north of Cove Mesa Mines (AEC Plot 7) (Figure 18) (Ref. 56, p.2). Samples 036-SSW01-01-100122 and 036-SSW02-01-100122 collected within the first 6 inches of the surface at Cato Sells – 36 mine have concentrations of arsenic at 9.8 mg/kg, lead at 14 mg/kg, uranium at 146 mg/kg, and Ra-226 at 36 pCi/g (Refs. 194, pp.54,56; 201, p.40). Background sample COVE-SSBG02-01-100322 has concentrations of arsenic at 0.96 mg/kg, lead at 4.1 mg/kg, uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
4. Cove Mesa Mines (AEC Plot 7 – 37)	Cove Mesa Mines (AEC Plot 7) are located north of East Mesa Mines (Figure 18) (Ref. 59, p.3). Samples 037-SSW01-01-100122 and 037-SSW03-01-100122 collected within the first 6 inches of the surface at AEC Plot 7 – 37 mine have concentrations of arsenic at 8.0 mg/kg, uranium at 78 mg/kg, and Ra-226 at 26 pCi/g (Refs. 194, pp.44,50; 201, p.37). Background sample COVE-SSBG02-01-100322 has concentrations of arsenic at 0.96 mg/kg, lead at 4.1 mg/kg, uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
5. Cove Mesa Mines (AEC Plot 7 – 38)	Cove Mesa Mines (AEC Plot 7) are located north of East Mesa Mines (Figure 18) (Ref. 59, p.3). Samples 038-SSW02-01-100122 and 038-SSW03-01-100122 collected within the first 6 inches of the surface at AEC Plot 7 – 38 mine have concentrations of uranium at 142 mg/kg, and Ra-226 at 423 pCi/g (Refs. 194, p.52; 203, p.35). Background sample COVE-SSBG02-01-100322 has concentrations of arsenic at 0.96 mg/kg, lead at 4.1 mg/kg, uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
6. Cove Mesa Mines (AEC Plot 7 – 39)	Cove Mesa Mines (AEC Plot 7) are located north of East Mesa Mines (Figure 18) (Ref. 59, p.3). Sample 039-SSW03-01-100122 collected within the first 6 inches of the surface at AEC Plot 7 – 39 mine has concentrations of arsenic at 10 mg/kg, lead at 21 mg/kg, uranium at 552 mg/kg, and Ra-226 at 155 pCi/g (Refs. 194, p.42; 201, p.33). Background sample COVE-SSBG02-01-100322 has concentrations of arsenic at 0.96 mg/kg, lead at 4.1 mg/kg, uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
7. Cove Mesa Mines (AEC Plot 7 – 430)	Cove Mesa Mines (AEC Plot 7) are located north of East Mesa Mines (Figure 18) (Ref. 59, p.3). Samples 430-SSW03-01-100122 and 430-SSW02-01-100122 collected within the first 6 inches of the surface at AEC Plot 7 – 430 mine have concentrations of arsenic at 9.8 mg/kg, uranium at 316 mg/kg, and Ra-226 at 78 pCi/g (Refs. 195, pp.52,54; 202, p.38). Background sample COVE-SSBG02-01-100322 has concentrations of arsenic at 0.96 mg/kg, lead at 4.1 mg/kg, uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
8. Cove Mesa Mines (AEC Plot 7 – 431)	Cove Mesa Mines (AEC Plot 7) are located north of East Mesa Mines (Figure 18) (Ref. 59, p.3). Sample 431-SSW01-01-100122 collected within the first 6 inches of the surface at AEC Plot 7 – 431 mine has concentrations of uranium at 5.6 mg/kg and Ra-226 at 4.37 pCi/g (Refs. 195, p.48; 202, p.35). Background sample COVE-SSBG02-01-100322 has concentrations of uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
9. Cove Mesa Mines (AEC Plot 7 – 434)	Cove Mesa Mines (AEC Plot 7) are located north of East Mesa Mines (Figure 18) (Ref. 59, p.3). Sample 434-SSW01-01-100122 collected within the first 6 inches of the surface at AEC Plot 7 – 434 mine has concentrations of uranium at 8.8 mg/kg and Ra-226 at 12.8 pCi/g (Refs. 195, pp.56; 202, p.39). Background sample COVE-SSBG02-01-100322 has concentrations of uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).

Table 71. Summary of Other Possible AOCs	
Other Possible AOC Names	**Other Possible Areas of Observed Contamination Description (Reference)**
10. Cove Mesa Mines (AEC Plot 7 – 497)	Cove Mesa Mines (AEC Plot 7) are located north of East Mesa Mines (Figure 18) (Ref. 59, p.3). Samples 497-SSW03-01-093022 and 497-SSW01-01-093022 collected within the first 6 inches of the surface at AEC Plot 7 – 497 mine have concentrations of arsenic at 5.5 mg/kg, lead at 17 mg/kg, uranium at 269 mg/kg, and Ra-226 at 63 pCi/g (Refs. 195, pp.42,38; 202, p.32). Background sample COVE-SSBG02-01-100322 has concentrations of arsenic at 0.96 mg/kg, lead at 4.1 mg/kg, uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
11. Cove Mesa Mines (AEC Plot 7 – 498)	Cove Mesa Mines (AEC Plot 7) are located north of East Mesa Mines (Figure 18) (Ref. 59, p.3). Samples 498-SSW02-01-093022 and 498-SSW03-01-093022 collected within the first 6 inches of the surface at AEC Plot 7 – 498 mine have concentrations of arsenic at 16 mg/kg, lead at 25 mg/kg, uranium at 1,490 mg/kg, and Ra-226 at 303 pCi/g (Refs. 195, p.46; 196 p.24; 202, p.34). Background sample COVE-SSBG02-01-100322 has concentrations of arsenic at 0.96 mg/kg, lead at 4.1 mg/kg, uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
12. Cove Mesa Mines (AEC Plot 7 – 501)	Cove Mesa Mines (AEC Plot 7) are located north of East Mesa Mines (Figure 18) (Ref. 59, p.3). Samples 501-SSW03-02-100122 and 501-SSW01-01-100122 collected within the first 6 inches of the surface at AEC Plot 7 – 501 mine have concentrations of arsenic at 18 mg/kg, lead at 45 mg/kg, uranium at 5,590 mg/kg, and Ra-226 at 621 pCi/g (Refs. 196, pp.32,26; 203, p.25). Background sample COVE-SSBG02-01-100322 has concentrations of arsenic at 0.96 mg/kg, lead at 4.1 mg/kg, uranium at 0.60 mg/kg, and Ra-226 at 0.84 pCi/g (Refs. 196, p.44; 203, p.34).
13. East Mesa Mines	East Mesa Mines are located northeast of West Mesa Mine in the Red Valley Chapter (Figure 18) (Ref. 58, p.2). Samples 493-SSW01-01-093022 and 493-SSW04-01-093022 collected within the first 6 inches of the surface have concentrations of arsenic at 2.8 mg/kg, lead at 18 mg/kg, uranium at 1,070 mg/kg, and Ra-226 at 368 pCi/g (Refs. 195, pp. 30,36; 202, p.29). Background sample Cove-SSBG-01-093022 has concentrations of arsenic at 0.79 mg/kg, lead at 3.8 mg/kg, uranium at 0.28 mg/kg, and Ra-226 at 0.42 pCi/g (Refs. 196, p.22; 203, p.23).
14. West Mesa Mine	West Mesa Mine is in the Round Rock Chapter near the Red Valley Chapter and Round Rock Chapter border. The mine is southwest of East Mesa Mines (Figure 18) (Ref. 57, p.2). Sample 040-SSW02-01-093022 collected within the first 6 inches of the surface has concentrations of arsenic at 3.9 mg/kg, lead at 31 mg/kg, uranium at 1,020 mg/kg, and Ra-226 at 263 pCi/g (Refs. 194, p.36; 201, p.30). Background sample Cove-SSBG-01-093022 has concentrations of arsenic at 0.79 mg/kg, lead at 3.8 mg/kg, uranium at 0.28 mg/kg, and Ra-226 at 0.42 pCi/g (Refs. 196, p.22; 203, p.23).

5.1.1 RESIDENT POPULATION THREAT

5.1.1.1 LIKELIHOOD OF EXPOSURE

Three samples comprising AOC 49 were collected from within the fence surrounding the Cove Day School. All three samples were collected within 200 feet of the main school building. The one sample in AOC 50 that establishes observed contamination at Residence 1 is located within 200 feet of the residential dwelling. Sample numbers, distances, and references for this paragraph are provided in the table below. The AOC 50 sample is on land owned by the Bureau of Indian Affairs, as is Residence 1, with no private property boundary between.

Table 72. Resident Population AOC Samples		
Sample ID	**Distance of Population/Resource from Area of Observed Contamination**	**References**
472-SSW06-01-072022	166 feet (Cove Day School)	73, pp.42,2154
472-SSW10-01-072022	139 feet (Cove Day School)	73, p.2155
472-SSW12-01-072022	192 feet (Cove Day School)	73, pp.45,2155
472-SSW04-01-072022	137 feet (Residence 1)	73, pp.41,2153,2157

Resident Population Threat Likelihood of Exposure Factor Category Value: 550

5.1.1.2 WASTE CHARACTERISTICS

5.1.1.2.1 Toxicity

Table 73. Toxicity		
Hazardous Substance	**Toxicity Factor Value**	**References**
Arsenic	10,000	2, p.2
Lead	10,000	2, p.5
Radium 226	10,000	2, p.8
Uranium	10,000	2, p.11

Toxicity Factor Value: 10,000

5.1.1.2.2 Hazardous Waste Quantity

Table 74. AOC Hazardous Waste Quantity Values			
AOC Number	**Source Type**	**AOC Hazardous Waste Quantity**	**AOC Hazardous Constituent Quantity Complete?**
1	Pile	513.77	No
2	Pile	1,929.38	No
3	Pile	3,664.12	No
4	Pile	3,047.01	No
5	Pile	2,590.85	No
6	Pile	1,831.74	No
7	Pile	1,140.65	No
8	Pile	972.99	No
9	Pile	1,177.87	No
10	Pile	159.41	No
11	Pile	683.33	No
12	Pile	3,939.00	No
13	Pile	659.72	No

Table 74. AOC Hazardous Waste Quantity Values			
AOC Number	**Source Type**	**AOC Hazardous Waste Quantity**	**AOC Hazardous Constituent Quantity Complete?**
14	Pile	2,255.06	No
15	Pile	51.24	No
16	Pile	863.63	No
17	Pile	12.82	No
18	Pile	1,964.61	No
19	Pile	1,274.03	No
20	Pile	115.29	No
21	Pile	350.18	No
22	Pile	5,136.48	No
23	Pile	3,380.80	No
24	Pile	634.76	No
25	Pile	429.21	No
26	Pile	7,040.54	No
27	Pile	908.58	No
28	Pile	Unknown but >0	No
29	Pile	5,378.56	No
30	Pile	1,339.33	No
31	Pile	896.82	No
32	Pile	1,459.08	No
33	Pile	80.88	No
34	Pile	1,638.51	No
35	Pile	1,448.22	No
36	Pile	2,410.16	No
37	Pile	1,237.64	No
38	Pile	949.21	No
39	Pile	399.23	No
40	Pile	149.44	No
41	Pile	Unknown but >0	No
42	Pile	Unknown but >0	No
43	Pile	Unknown but >0	No
44	Pile	Unknown but >0	No
45	Pile	Unknown but >0	No
46	Pile	Unknown but >0	No
47	Pile	Unknown but >0	No
48	Pile	Unknown but >0	No
49	Contaminated Soil	Unknown but >0	No
50	Contaminated Soil	Unknown but >0	No
51	Pile	8,258.26	No

Sum of Values: >72,372.41

Hazardous Waste Quantity Factor Value: 10,000
(Ref. 1, Table 2-6)

5.1.1.2.3 Calculation of Waste Characteristics Factor Category Value

Toxicity Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 10,000

Toxicity Factor Value x Hazardous Waste Quantity Factor Value: 100,000,000

Waste Characteristics Factor Category Value: 100
(Ref. 1, Table 2-7)

5.1.1.3 TARGETS

Level I Concentrations

Sample ID: 472-SW06-01-072022
AOC Number: 49
Reference for Benchmark: 2, pp.11

Table 75. Level I Concentrations for Sample ID: 472-SW06-01-072022			
Hazardous Substance	**Hazardous Substance Concentration (units)**	**Benchmark Concentration**	**Benchmark**
Uranium	31,000 mg/kg	15.6 mg/kg	Non-Cancer Risk

Sample ID: 472-SW10-01-072022
AOC Number: 49
Reference for Benchmark: 2, pp.11

Table 76. Level I Concentrations for Sample ID: 472-SW10-01-072022			
Hazardous Substance	**Hazardous Substance Concentration (units)**	**Benchmark Concentration**	**Benchmark**
Uranium	2,400 mg/kg	15.6 mg/kg	Non-Cancer Risk

Sample ID: 472-SW12-01-072022
AOC Number: 49
Reference for Benchmark: 2, pp.11

Table 77. Level I Concentrations for Sample ID: 472-SW12-01-072022			
Hazardous Substance	**Hazardous Substance Concentration (units)**	**Benchmark Concentration**	**Benchmark**
Uranium	6,600 mg/kg	15.6 mg/kg	Non-Cancer Risk

Sample ID: 472-SSW04-01-072022
AOC Number: 50
Reference for Benchmark: 2, p.11

Table 78. Level I Concentrations for Sample ID: 472-SSW04-01-072022			
Hazardous Substance	**Hazardous Substance Concentration (units)**	**Benchmark Concentration**	**Benchmark**
Uranium	100 mg/kg	15.6 mg/kg	Non-Cancer Risk

5.1.1.3.1 Resident Individual

AOC Numbers: 49 and 50
Level of Contamination (Level I/Level II): Level I
References: 1, Section 5.1.1.3.1; 2, pp.11,14

Resident Individual Factor Value: 50

5.1.1.3.2 Resident Population

5.1.1.3.2.1 Level I Concentrations

Level I Resident Population Targets

There are 42 students associated with the Cove Day School (AOC 49), and two residents associated with AOC 50 (Refs. 70; 73, p. 17).

Table 79. Level I Resident Population					
AOC Number	**Sample ID**	**Number of Buildings**	**County Multiplier**	**Population**	**References**
49	472-SW06-01-072022	1	NA	42	70, p. 1; 73, p.17
	472-SW10-01-072022				
	472-SW12-01-072022				
50	472-SSW04-01-072022	1	NA	2	73, p.16, 2153, 2157

Sum of individuals subject to Level I concentrations: 42 (Students) + 2 Residents (at Residence 1) = 44
Sum of individuals subject to Level I concentrations x 10: 440

Level I Concentrations Factor Value: 440

5.1.1.3.2.2 Level II Concentrations

Level II Samples

There are no Level II resident individuals.

Level II Resident Population Targets

There are no Level II resident individuals.

5.1.1.3.3 Workers

15 workers are associated with the Cove Day School (Ref 70, p. 1).

Table 80. Workers		
AOC Number	**Number of Workers**	**References**
49	15	70, p.1

Total workers: 15

Workers Factor Value: 5
(Ref. 1, Table 5-4)

5.1.1.3.4 Resources

Description of Resource(s): None

5.1.1.3.5 Terrestrial Sensitive Environments

Mexican spotted owls (strix occidentalis lucida) inhabit the canyons and mesas in the Cove Wash watershed (Refs. 72, p. 5; 192, p. 27). Past Mexican spotted owl surveys have resulted in the creation of Protected Activity Centers to protect the Cove Wash watershed populations (Ref. 72, p. 5). For Mexican spotted owls, the US Fish and Wildlife Service defines PACs to include all known owl sites and all areas in mixed-conifer or pine-oak types with slopes greater than 40 percent where timber harvest has not occurred in 20 years, and all legally and administratively reserved lands, such as Wilderness Areas or Research Natural Areas. Protected areas can also include steep-walled canyon habitat. Owl PACs are delineated around known owl sites. PACs include a minimum of 600 acres (ac) (243 hectares [ha]) that includes the best nesting and roosting (i.e., resting) habitat in the area. A PAC contains the nest site, a roost grove commonly used during the breeding season in the absence of a verified nest site, or the best nesting/roosting habitat if both nesting and roosting information are lacking and the most proximal and highly used foraging areas. Areas outside of PACs, including restricted areas, provide additional habitat appropriate for foraging (Ref. 224, p. 3). See Figure 20 for location of PACs and habitat surrounding the PACs used by MSO.

The entire Lukachukai mountains are relatively small compared to the Navajo Nation and they comprise a unique biotic community important to the culture and lifeways of the Diné people. Diné medicine men and other tribal members use the Lukachukai mountains to harvest numerous unique herbs and plants that grow in few other areas across the Navajo Nation. The Lukachukai mountain biotic community of Douglas fir, ponderosa pine, piñon pine and juniper forests and numerous deeply incised washes create habitat for medicinal and ceremonial herbs that grow in few other areas on the Navajo Nation. The specific herbs and other plant species used by the Diné people for ceremonial and medicinal purposes are held in confidence among tribal members, and thus specific plant community locations are unknown, but prevalent in the Lukachukai mountains. Diné medicine men, elders, and others travel from all over the Navajo Nation to sustainably harvest these herbs for ceremonial and medicinal purposes (Ref. 66).

The entire Lukachukai mountains are an important terrestrial breeding area utilized for breeding by large and/or dense aggregations of animals used culturally by the Diné people. The Lukachukai mountain biotic community of

Douglas fir, ponderosa pine, piñon pine and juniper forests create habitat for a large and/or dense aggregation of large vertebrate species used to sustain the Diné people. Important large vertebrate species in the Lukachukai Mountains include populations of elk, mule deer, bear, cougar, white-tail deer, and others. Local Navajo elders such as Cove Chapter President James Benally attest to the importance to protect the entire Lukachukai mountains to sustain the breeding populations of these important vertebrate mammal species (Ref. 67).

Zuni fleabane (Erigeron rhizomatous) occur along, steep, barren, weathered slopes of northeast, north, west facing escarpment of Lukachukai Mountains. Habitat for the Zuni fleabane includes steep, barren slopes in ponderosa pine, Douglas fir, and pinyon – juniper woodland communities, specifically in the weathered Chuska Sandstone, and upper Chinle Formation geologies. Biological surveys in the Cove Wash watershed show that Zuni fleabane habitat occurs within the Cove Wash watershed overlapping with the AOCs (Refs. 192, pp. 22,23; 205, pp. 223,224).

Golden eagles are present throughout the Navajo Nation. The Carrizo, Chuska, and Lukachukai Mountains all provide habitat for golden eagles. Golden eagles are known to inhabit Mexican Cry mesa and Lukachukai Mountains. Specific habitat characteristics include isolated, laterally extensive, vertical cliff walls, remote ponderosa pine forest, or any isolated buttes and mesas with cliff faces and ledges (Ref. 192, p. 26). These conditions are present throughout the LMMD and at all the AOCs.

AOCs 1 through 51 are located within the boundaries of terrestrial sensitive environments (Refs. 192, pp. 21-27; 68, pp.1-4; 62, p.63). Affected environmental targets and the AUM locations are listed in the table below.

Table 81. Terrestrial Sensitive Environments

AOC Letter	Terrestrial Sensitive Environment	Assigned Value (Ref. 1, Table 5-5)	References
1 to 32	Federal threatened species – Mexican spotted owl (*Strix occidentalis lucida*)	75	69, p.2; 72, pp. 8,12-16,20
1 thru 48	Federal threatened species – Zuni fleabane (*Cirsium chellyense*)	75	69, p.8; 192, pp.22,23
1 thru 48	Terrestrial area used for breeding by large or dense aggregation of vertebrate animals – elk (*Cervus elephus*), mule deer (*Odocoileus hemionus*), American black bear (*Ursus americanus*), cougar (*Puma concolor*), white-tail deer (*Odocoileus virginianus*)	75	67
1 thru 51	State (tribal) endangered species – golden eagle (*Aquila chrysaetos*)	50	68, p.2; 92, p. 26
1 thru 51	Particular area relatively small in size important to the maintenance of a unique biotic community – the Lukachukai Mountains is an important area for medicinal and cultural herb collection for the Navajo people. There are many species spread throughout these mountains.	25	67

Likelihood of exposure factor category value (LE): 550
Waste characteristics factor category value (WC): 100
Terrestrial sensitive environments value (ES): 300

Product (LE x WC x ES): 16,500,000
(LE x WC x ES)/82,500: 200

If result is >60, Value of EC = 60 x 82,500/(LE x WC): 90

Terrestrial Sensitive Environments Factor Value: 90

5.1.2 NEARBY POPULATION THREAT

The nearby population threat has not been scored.